A REVISION OF THE AMERICAN MOLES.

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THE EXISTENCE of moles in North America was known to naturalists at least as early as the middle of the eighteenth century. Under date of October 12, 1748, Kalm mentions seeing burrows of a mole on the banks of the Schuylkill River at Philadelphia. He remarks on the characteristics of an individual kept in captivity, but it is not clear from his account at what time it came under his observation, though probably not long after the date cited above.[1]

The first explicit mention of specimens which I find is that of Barrington in the Philosophical Transactions in 1772.[2]

Barrington wrote to the secretary of the Royal Society of London, under date of May 15, 1771, as follows:

> I send herewith a mole from North America, which Mr. Knekahn (who hath before presented several birds and insects to the Society) desires they will do him the honour to place in their Museum.

From the description which follows, it appears probable that the specimen (which included part of the skull) was our common mole, *Scalops aquaticus*.

There is a reference to specimens of almost the same date in Boddaert's translation of Linnæus's Systema Naturæ in 1772.[3] In a footnote, under the heading of *Sorex cristatus*, he remarks:

> This very rare species makes a connection between the mole and shrew. It is more like a mole than a shrew. I have seen the same in the celebrated cabinet of Mr. Van der Meulen in Amsterdam.

Linnæus may have found specimens of American moles in the Swedish museums to which he had access, though it is improbable; if not, he must have received correct descriptions or specimens from Kalm, who traveled in America for him and was in correspondence with him. Linnæus diagnoses the species correctly, which he could

[1] Kalm's Travels, Forster's English Trans., I, 1770, p. 190. The species was probably *Scalops aquaticus*, but Forster believed that it was *Condylura*.

[2] Account of a Mole from North America: In a letter to Dr. Maty, Sec. R. S., from the Hon. Daines Barrington, F. R. S., Phil. Trans., LXI, pt. 1, p. 292.

[3] Boddaert, Linn. Nat., I, 1772, p. 51.

not have done from the statements of Seba, who, if my view is correct, did not have any American specimens of moles, though he describes some as such.[1]

The records mentioned thus far relate to *Scalops aquaticus* or *Condylura cristata*, but William Bartram (born in 1739, died in 1823) seems to have known at an early date of the existence of the species now called Brewer's mole, *Parascalops breweri*. There is a reference to his manuscript name, "*Talpa americana*, black mole" (but no description), in Harlan's Fauna Americana of 1825.[2] There were specimens of Brewer's mole in London prior to 1829, but they were not recognized as such, and the species was not formally described until 1842, when Bachman published a notice of it.

The Pacific Coast mole, *Scapanus townsendi*, came under the observation of Lewis and Clarke between 1804 to 1806, but they did not recognize the fact that it was different from the species of the Atlantic Coast.[3] This was reserved for Bachman in 1839. There were specimens in the museum of the Hudson's Bay Company, however, prior to 1829.

The very remarkable little mole of the Pacific Coast, *Neürotrichus gibbsii*, remained unknown to science until 1857, when it was described by Professor Baird from a specimen collected in 1854 by George Gibbs.

Many zoologists, beginning with Linnæus, were disposed to regard the American moles as shrews. Linnæus placed both the common Eastern mole and the Star-nosed mole in his genus *Sorex*, which is practically equivalent to the family *Soricidæ* of the present day. This view was opposed by Pennant as early as 1771, who places the American forms known to him with the moles.[4]

Most unfortunately, however, he classifies his "Yellow Mole," which he got from New York, and was really *Scalops aquaticus*, as a variety of the European mole. The consequence was that the impression prevailed, even as late as 1829, that a variety of the European mole (i. e., a representative of the genus *Talpa*) existed in America.[5] The truth was obscured also from the fact that there were specimens in London at a comparatively early date of Brewer's mole, which in color resembles the European mole. After 1831, when Godman expressed disbelief in the occurrence of *Talpa* in America, that generic name as applied to

[1] As will appear later, Seba's "*Talpa, rubra, Americana*" (supposed to be from the West Indies), represented in his plate 32, is probably a *Chrysochloris;* while his *Talpa, Virginianus, niger*, supposed to be from Virginia, is an European mole. (SEBA, Thesaurus, I, pl. 32.)

[2] Page 43.

[3] See COUES'S Lewis and Clarke's Expedition, 1804–1806, III, 1893, p. 864.

[4] Synopsis of Quadrupeds, 1771, p. 315 (*fide* Fischer). I have not seen this work. In the 3d edition (History of Quadrupeds), II, 1793, p. 233, he remarks: "Linnæus places this [i. e., *Scalops aquaticus*] and our radiated mole in his class of Sorex, or shrew, on account of the difference of the teeth; but as these animals possess the stronger characters of the mole, such as form of nose and body, shape of feet, and even the manner, we think them better adapted to this genus than to the preceding."

[5] See Richardson, Fauna Bor. Amer., Quad., I, 1829, p. 12.

American forms seems to have finally disappeared from the literature.[1]

The history of the classification of the *Insectivora* has been ably expounded by Dr. Gill,[2] and it is unnecessary for me in this connection to treat of it in detail. I shall content myself with running over the principal phases of the matter as relates to the *Talpidæ*, beginning at a somewhat earlier date than Dr. Gill has done, and including some systems which he has omitted.

In Linnæus' time and for a half century afterwards the genera of animals were grouped together in orders without intermediate segregation as families. The genera were, however, in many cases practically equivalent in value to family divisions as employed at the present day. In 1813 Fischer proposed a classification of mammals, based on the structure of the feet, into which family divisions as now used were introduced. He divides mammals into *Quadrupeda* and *Cetacea* (or *Apoda*), and the former again into *Fissipeda* and *Plectopoda*. The *Fissipeda* are again divided into *Unguiculata* and *Ungulata*. The *Unguiculata* comprises five orders, one of which, the *Plantigrada*, includes four families, namely: *Erinacini*, *Soricini*, *Talpini*, and *Ursini*. The family *Talpini* contains three genera, namely: *Talpa*, *Scalops*, and *Chrysochloris*. The species are as follows: *Talpa europæa*, *Scalops cristatus* (=*Condylura cristata*), *Chrysochloris capensis*.

Our star-nosed mole, in this system, belongs to the order *Plantigrada*, family *Talpini*, and genus *Scalops*. The system as a whole is of little merit, considering that the bears are placed in the same order with the moles, while the musk shrew, *Mygale*, on account of its webbed feet, is placed in an entirely different division of the class.

In 1821 we find the American moles placed with others by Dr. Gray[3] in a family called *Mygalade*,[4] with the following genera: *Mygale*,[4] *Scalops*, *Condylura*, *Chrysochloris*.

The construction of this family is somewhat more satisfactory than that of Fischer, in that *Mygale* is included; but the inclusion of *Chrysochloris* and the singular omission of *Talpa* are serious defects.[5]

In 1825, and for nearly twenty years afterwards, Dr. Gray employed a system which, so far as the family in which we are interested is concerned, was distinctly inferior to the earlier one.[6] He united all the

[1] It is true that it occurs in De Blainville's Osteographie, published between 1839 and 1861, but as he employs the name *Scalops* as a subgeneric term the case is hardly one in point. I should mention, however, that two specimens from North America are marked *Talpa europæa* with a query in Waterhouse's catalogue of the mammalia in the museum of the Zoological Society of London, published in 1838 (p. 16).

[2] Synopsis of Insectivorous Mammals. Bull. U. S. Geog. and Geol. Survey of the Territories, No. 2, 2 ser., 1875, p. 91.

[3] On the natural arrangement of vertebrose animals. London Medical Repository, XV, 1821, pp. 296–310.

[4] In these names the letter g is omitted in the original, but this is evidently a typographical error, of which there are many in the article.

[5] No notice is taken here of the more general features of this classification. For these, reference should be made to Dr. Gill's Synopsis.

[6] Annals of Philosophy, XXVI (new series X), 1825, p. 337.

insectivorous mammals then known in the single family *Talpidæ*. It might be supposed that this was merely a case of employing the term family in the sense of order, but such is not the truth, as appears from the fact that the *Talpidæ* with other families was included in the order *Feræ*.

The system proposed by Bonaparte in 1831 does not differ essentially so far as the family *Talpidæ* is concerned from that of Fischer and the earlier one of Gray, but the genus *Talpa* is restored to its proper place. His section *Talpina* of the family *Talpidæ* comprises the genera *Talpa*, *Condylura*, *Chrysochloris*, *Scalops*.[1] A remarkable feature of his classification is that the family *Talpidæ* (which he also styles *Insectivora*, a name now used for the order) is placed under the order *Chiroptera*.

Pomel's system proposed in 1848 has no merit so far as the moles as a whole are concerned, as he brings them into one group, called the family *Spalacogalæ*, with the shrews and such other genera as *Chrysochloris* and *Solenodon*.[2]

The divisions which he makes in his tribe (or subfamily) *Talpina*, however, leaving out of consideration the fossil forms and the remote genera mentioned above, are nearly such as are now current. With the eliminations mentioned, we have the following:

First tribe—Talpina.
  First type—[Pachyrhiniens.]
    Talpa.
    Mogera.
    Astromycter [=Condylura.]
  Second type—[Leptorhiniens.]
    Scalops.
    Scapanus.
Second tribe—Mygalina.
  First type—[Amblysomiens.]
  Second type—[Macruriens.]
    Mygale.
  Third type—[Unnamed].
    Urotrichus.[3]

Gervais's system, published in his Natural History of Mammals in 1854, is hardly more satisfactory, as he classifies *Urotrichus* and *Mygale* with the shrews, and leaves *Chrysochloris* among the moles.[4] His arrangement is as follows:

Famille des Talpidés.
  Tribu des Chrysochlores.
    Genre Chrysochlore (Chrysochloris).
  Tribu des Scalopes.
    Genre Scalope (Scalops).

[1] Bonaparte, Saggio Dist. Metod. Ann. Vert., 1831, p. 16.

[2] Archiv. Sci. Phys. et Nat., IX, 1848, pp. 244–252.

[3] Dr. Gill, in his abstract of the system, has added the words "Japan, California," to the name of this genus, from which it might be inferred that Pomel knew of the occurrence of an *Urotrichus*-like mole in California at this early date (1848). This is not really the case, however. In Bull. Geol. Soc. France, 2 ser., VI, 1848, p. 58, Pomel remarks "Le genre *Urotrichus* ne sort pas du Japon."

[4] Histoire naturelle des mammifères, I, 1854–55, p. 250.

Famille des Talpidés—Continued.
Tribu des Condylures.
Genre Condylure (Condylura).
Tribu des Taupes.
Genre Taupe (Talpa).

Though in French form, the names of the tribes correspond more closely to those now in use than do Pomel's. Like Pomel, he has separated *Chrysochloris* under a distinct tribal name, which was a step toward its final elimination from the family *Talpidæ*.

In the supplement to Schreber's *Säügethiere*, by J. A. Wagner, published in 1855, the classification is simple in that the genera of moles are brought together under a family designation (*Talpina*), without intermediate divisions. His arrangement is defective in that he includes *Chrysochloris* in the family and places *Mygale* with the shrews. Peters employed the same form for the family in 1864, but included *Mygale*.[1]

In these two instances there is no special improvement, so far as this family is concerned, over Gray's classification of 1821.

It was reserved for Dr. Mivart, in 1867, to finally remove *Chrysochloris* to a distinct family established for its reception. The moles were then classified as follows:

Family Talpidæ.
Subfamily Talpina.
Scalops.
Scapanus.
Condylura.
Talpa.
Subfamily Myogalina.
Urotrichus.
Myogale.[2]

We come finally to Dr. Gill, who accepted Mivart's arrangement of the family, but elaborated it by dividing the two subfamilies into sections, as follows:

Family Talpidæ.
Subfamily Talpinæ.
(Talpæ).
Talpa.
Mogera.
Parascaptor.
Scaptochirus.
Scaptonyx.
(Condyluræ).
Condylura.
(Scalopes).
Scalops.
Scapanus.
Subfamily Mygalinæ.
(Mygalæ).
Desman (=Mygale).
(Urotrichi).
Urotrichus.
Uropsilus.[3]

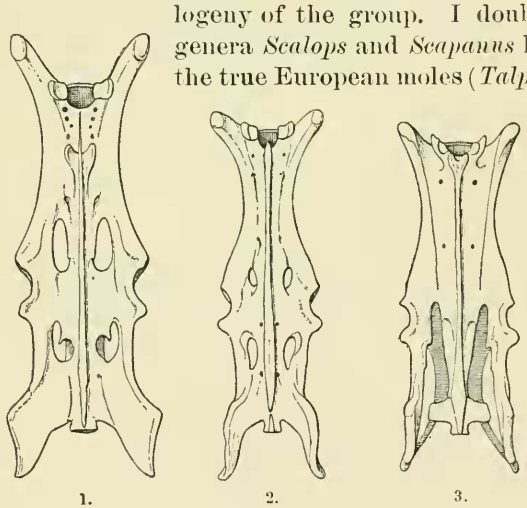
[1] Monatsberichte Akad. Wissensch. Berlin, 1865, p. 286.
[2] Journ. Anat. & Physiol., I, 1867, p. 281.
[3] Bull. Geol. and Geog. Survey of the Territories, No. 2, 2 ser., 1875, p. 110.

The last reviewer of the group, the late Dr. Dobson, adopts Dr. Gill's arrangement, only adding the genus *Scaptonyx* and placing *Uropsilus* in a separate section (*Uropsili*).[1] It is to be observed, however, that he does not formally divide the family into the two subfamilies *Mygalinæ* and *Talpinæ*, since he does not regard the characters on which these distinctions are founded as sufficiently trenchant. In this I agree with him, though for convenience I have employed the divisions in the key on p. 7.

The aberrant genus *Condylura*, though placed with the typical moles in the subfamily *Talpinæ*, has the pterygoid region of the skull only moderately inflated, a manubrium sterni short in comparison with that of *Scalops* and the like, and the clavicles somewhat elongated. In all these respects it shows a leaning toward the genera which are placed in the subfamily *Mygalinæ*.

On the other hand, *Neürotrichus*, a member of the *Mygalinæ*, has a considerably inflated pterygoid region.

Further, it is perhaps questionable whether such a subdivision of the family as that under consideration aids in understanding the phylogeny of the group. I doubt whether the American genera *Scalops* and *Scapanus* have been connected with the true European moles (*Talpa*, etc.) at any recent time. *Condylura* is a greatly modified genus, having no representative in Europe, though possibly remotely connected with *Urotrichus*, through *Neürotrichus* and *Parascalops*. The genus *Neürotrichus* is, of course, very closely allied to *Urotrichus*, but this is the only case in which an Old World type is represented in the New World. The moles are an old family, and very little is known of their geological history. Hence, in my opinion, speculations as to the derivation of the various forms now existing and their true relationships are in many cases of little value. We have among American mammals both forms which are (geologically speaking) quite recent importations from the Old World, and others which are indigenous, or at least have had representatives on the American continent for a very long time. So far as the moles are concerned the present condition of knowledge is not such as to enable us in the majority of cases to distinguish between the two classes. At all events it does not seem to



1. 2. 3.

PELVES OF MOLES.

Fig. 1, Scapanus. Fig. 2, Scalops. Fig. 3, Parascalops.

(Twice natural size.)

[1] Monogr. Insectivora, part 2, 1883, p. 128.

me that the finding of *Neürotrichus*, a close ally of *Urotrichus*, in America is a sufficient basis for regarding all the American moles as importations from the Old World.

As regards the position of the American moles in the classification employed by Dr. Gill and modified by Dr. Dobson, it may be remarked first that *Condylura* is very properly placed in a separate supergenus (*Condyluræ*), as this form is an isolated one, presenting many peculiarities not shared by the other genera. The supergenus *Scalopes*, which comprises *Scalops* and *Scapanus*, I can not accept, since *Scapanus*, as here used, includes *Parascalops*, which I think should be separate.

Brewer's mole, *Parascalops*, shows considerable affinity with *Condylura* in the form of the pelvis, the tympanic bones, and the molars, but in most other characters it is, of course, remarkably different.

I regard *Parascalops* as bridging over in some degree the gap between the aberrant *Condylura* and the very closely allied genera *Scalops* and *Scapanus;* but, on the other hand, the remark of Flower and Lydekker that *Scapanus* and *Parascalops* "have a dentition like *Condylura*,"[1] does not seem to me warranted.

The American genera of moles may be arranged as follows:

KEY TO THE GENERA OF AMERICAN MOLES.

A. Subfamily Talpinæ.—Pterygoid region of skull inflated; no distinct pterygoid fossa. Clavicle short and broad. Carpus with an *os falciforme.*

a. Pelvis with two bony bridges connecting the sacral vertebræ with the ischium. Tympanic bullæ complete. Molars with a narrow, simple internal basal projection.

aa. Premolars $\frac{3}{3}$. No functional lower canine; lower incisors, two. Second and third upper incisors, minute ..... *Scalops*

Type: *Scalops aquaticus.*

bb. Premolars $\frac{3}{4}$ or $\frac{4}{4}$. Lower canine present; lower incisors, three.. *Scapanus*

Type: *Scapanus townsendi.*

b. Pelvis with no osseous bridges between the sacrum and ischium. Tympanic bullæ incomplete. Molars with a wide, trilobed basal projection.

cc. Premolars $\frac{4}{4}$, the anterior ones simple and close together. Nostrils simple ..... *Parascalops*

Type: *Parascalops breweri.*

dd. Premolars $\frac{4}{4}$; the anterior ones spaced, multicuspidate and two-rooted. Nostrils in a large fringed cutaneous disk ..... *Condylura*

Type: *Condylura cristata.*

B. Subfamily Mygalinæ.—Pterygoid region of skull not inflated; pterygoid fossa more or less distinct. Clavicle longer than broad. Carpus without an *os falciforme.*

ee. Front upper incisors broad. Premolars $\frac{3}{2}$ ..... *Neürotrichus*

Type: *Neürotrichus gibbsii.*

GEOGRAPHICAL DISTRIBUTION OF MOLES.[2]

The distribution of the several species of American moles is of interest from many points of view. Whether the moles are confined

[1] Mammals, p. 630.

[2] In the preparation of this revision, which has suffered numerous interruptions, I have had the use of several collections besides that of the National Museum. I am

within the faunal areas outlined by students of zoo-geography, from the investigation of other groups, whether their present distribution is fortuitous, or dependent on ascertained or ascertainable conditions of the environment, and what renders these conditions of importance, are among the questions which deserve consideration.

We have in North America, as already intimated, five genera of moles, *Scalops*, *Scapanus*, *Parascalops*, *Condylura*, and *Neürotrichus*. Two of these, namely, *Scapanus* and *Neürotrichus*, are Pacific Coast genera. Though the two genera are not closely related, their distributional areas coincide, but *Neürotrichus*, so far as known, extends by no means so far south as *Scapanus*.

East of the Rocky Mountains are the three remaining genera, *Scalops*, *Condylura*, and *Parascalops*. The last two, as in the case of the west coast genera, coincide in distribution to the extent that *Parascalops* occurs over the middle and southern portions of the area occupied by *Condylura*, and not elsewhere. But, so far as known, it does not range nearly so far north or west. Finally, *Scalops* has a range much exceeding that of the other two genera, with boundaries coinciding for no considerable distance in any direction.

Thus, while two or even three genera of moles will be found in a single locality, no two are found everywhere together. Though the east or west boundaries of two genera may coincide, the north and south boundaries fail to do so, or vice versa; or at least the area of the one genus will be found to exceed that of the other in some direction.

As already stated, such coincidences as do occur are not correlated with nearness of relationship, a fact which finds many parallels in the class of mammals generally.

The two investigators who have given most attention to the study of the geographical distribution of American mammals in recent years are Dr. J. A. Allen and Dr. C. H. Merriam.[1]

The systems of these two writers, based on the effects of climate, while they lead in the main to similar results, proceed from somewhat different principles, Dr. Merriam giving almost exclusive attention to temperature effects and relegating the moisture to an entirely secondary

indebted to Dr. C. Hart Merriam for the use of the very large collection made under his direction for the United States Department of Agriculture and of valuable specimens of *Condylura*, *Parascalops*, etc., from his private collection; to Dr. J. A. Allen, for the use of the collection of the American Museum of Natural History, New York; and to Mr. S. N. Rhoads, for opportunities to examine various interesting specimens in his private collection and in the Academy of Natural Sciences, Philadelphia. To these naturalists, and to the authorities of the institutions mentioned, I offer my sincere thanks, remembering their forbearance in allowing me to retain the collections for a very considerable period of time.

[1] J. A. Allen: The Geographical Distribution of North American Mammals. Bull. Amer. Mus. Nat. Hist., IV, 1892, pp. 199–244.

C. H. Merriam: North American Fauna, No. 3. The Geographical Distribution of Life in North America. Proc. Biol. Soc., Washington, VII, 1892, pp. 1–64. Laws of Temperature Control of the Geographic Distribution of Terrestrial Animals and Plants. Nat. Geog. Mag., VI, 1894, pp. 229–238, pls. 12–14.

place, while Dr. Allen views the effects of moisture as of a higher importance, in some cases surpassing those of temperature. A brief quotation from these two authors will reveal their respective attitudes.

In this latest paper Dr. Merriam remarks:

> Humidity and other secondary causes determine the presence or absence of particular species in particular localities within their appropriate zones, but temperature predetermines the possibilities of distribution; it fixes the limits beyond which species can not pass, it defines broad transcontinental belts within which certain forms may thrive if other conditions permit, but outside of which they can not exist, be the other conditions never so favorable.[1]

Dr. Allen remarks:

> Of strictly climatic influences, temperature is by far the most important, although moisture plays an influential part.
>
> Moisture alone may determine the character of life over extensive regions, regardless of temperature, which, under ordinary conditions, is the ascendant controlling influence.[2]

The terminology employed by Dr Allen is the more precise, and as he pays more attention to moisture in his faunal map than does Dr. Merriam, his system will receive the larger share of attention in the present connection.

It will be impossible to describe here in detail the regions laid down by Dr. Allen, and the reader is referred to his original maps and to those of Dr. Merriam.

The territory of the United States, with the exception of the principal mountain ranges and the addition of the Mexican plateau, is practically coextensive with the faunal area called by Dr. Allen the "Warm temperate subregion." This territory is divided by a north and south line, running a little east of the one hundredth meridian, into two "provinces"—the "humid" of the east and the "arid" of the west. The dividing line between these two provinces is a natural one, and one of much importance in connection with the group of animals we are now studying. As Dr. Allen remarks in regard to his two provinces, "they are not separated by isothermal lines, trending in an east and west direction, but by a north and south line, determined by the amount of rainfall. Thus, in the present instance, temperature as a climatic influence governing the distribution of animals and plants is subordinated to the other climatic influence, humidity, which varies greatly in these two contrasting regions, in consequence of the long-continued peculiar physiographic and geographic conditions of the two regions."[3]

North of the warm temperate region extends the cold temperate, stretching away northward to the limit of trees and southward along the principal mountain chains of the United States; also including the larger part of Maine, New Hampshire, and Vermont, together with northern Michigan, Wisconsin, Minnesota, and Dakota.

[1] Nat. Geog. Mag., VI, p. 238.

[2] Bull. Amer. Mus. Nat. Hist., IV, pp. 199, 200.

[3] Bull. Amer. Mus. Nat. Hist., IV, p. 230.

The most northern division of Dr. Allen's warm temperate subregion is separated under the name of the Alleghanian fauna. This includes the greater part of the northern tier of States (east of the one hundredth meridian), lower Canada, northeastern Ohio, the greater part of New York and Pennsylvania, and of the New England States (except the most elevated portions), and the Alleghanies. In Dr. Allen's system, therefore, this region is a part of the larger southern one.

Dr. Merriam looks upon this area as a neutral zone, connecting the northern and southern, but possessing no individuality of its own. He styles it the "transition zone." It is with this area that we are most concerned.

Upon examination of the maps which follow (pp. 28, 55, 74, 89, 103), it will be found that the boundaries of the areas of the several eastern genera coincide in some part with those of the faunal areas just mentioned.

Thus, the area of *Scalops* is almost exactly coextensive with and coincident with the humid province of the warm temperate subregion as marked out by Dr. Allen. But it goes a little farther west toward the one hundredth meridian and a little farther south to the Rio Grande (and perhaps a short distance south of it). Also, there is no certain evidence that *Scalops* reaches North Dakota and Manitoba. Except in these details the genus is strictly representative of the humid province.

There is, however, a certain peculiarity of the distribution of the genus that requires mention. It unquestionably occurs in the Alleghany Mountains—that is, in the southern extension of the cold temperate or boreal area.

In this particular, at least, following Dr. Allen's ideas, its distribution is not controlled by temperature, and we shall need to ask the question, Why does not this mole range farther north?

If we revert here to Dr. Merriam's system, we escape this difficulty, because the Alleghanies in his latest map are represented as belonging entirely to the "transition" zone, which is neutral and in which we may expect to find southern as well as northern forms.

The range of the genus *Condylura*, as will appear from examination of the map, is less in harmony with Allen's faunal areas. Thus, it extends to Hudson Bay on the north, to Indiana, Ohio, and the Alleghanies on the south, and also leaves the mountains and extends somewhat over the lower lands, to the east of them.

The genus, therefore, occupies at once parts of both the cold temperate and warm temperate regions, and, so far as one genus goes, tends to negative the distinctions made between these faunal regions, or at least to indicate that the "Alleghanian fauna" is not part of the warm temperate subregion. The matter assumes a more satisfactory aspect when viewed in connection with Dr. Merriam's scheme. In the terminology of his system, *Condylura* occupies a portion of the boreal region and of the transition zone, and a number of isolated fragments or islands of the latter to the south and east of the main area. Viewed

in this way, the distribution of the genus is not exceptional, but we shall still be obliged to inquire why it occupies only so small a part of the cold temperate or boreal subregion.

The genus *Parascalops*, as already stated, has a similar distribution to that of *Condylura*, but, so far as known, extends neither so far north nor so far west. It appears to remain entirely within the Alleghanian fauna (or transition zone), but does not occupy the whole of the area.

The two western genera, *Scapanus* and *Neürotrichus*, are found exclusively in the Pacific Coast States, with the addition, as far as known, of only a small area immediately northward, and in the case of one specimen, the San Pedro Martir Mountains in Lower California.

In the Pacific States these genera are confined to the area called cold temperate by Dr. Allen, or the boreal and transition areas of Dr. Merriam. In other words, they inhabit only the higher and better watered regions in the south, spreading out more and descending lower in the north. So far as known, *Neürotrichus* does not range south of San Francisco Bay, and hence does not fill out the whole of the southern extension of the cold temperate, as does *Scapanus*.

Having discussed in general terms the distribution of the several genera, and pointed out the peculiarities of their distribution, it remains to consider the causes of these peculiarities. In other words, it is desirable to inquire into the causes which limit or favor the distribution of the moles.

It is generally agreed, as we have seen, that temperature is the most potent agent in affecting distribution, and that next to it stands humidity. In the case of the moles, however, it would appear that humidity is at least as effective as temperature. This is evidenced in the case of *Scalops*, which occupies the Alleghanies, but stops at the plains. The case of *Scapanus* is probably also one in point, though the conditions here are not so simple. How, we may inquire, do differences in humidity affect the moles? Probably not to any great extent directly, but rather in connection with food supply. The common mole (*Scalops*), at least, lives almost exclusively on earthworms and burrowing insects. It should therefore abound and flourish most where these animals are most abundant and most easily obtainable. The latter condition is equally as important as the first, for while the worms may be abundant they may not be readily obtainable, as for example in rocky areas. If the ground is hard, the mole has great difficulty in traversing it, and he may not be able to sustain himself even in ground which contains more or less of worms and beetles. In regions having a dry summer, during which the ground is parched and made hard, he may subsist only with much difficulty. It is probably a debatable question, however, whether the mole can not dig wherever the worm can bore, but it is quite certain that worms could continue to exist in small colonies where the difficulties of finding them would tax too greatly the powers of the mole.

I have been unable as yet to ascertain anything of a definite character in regard to the distribution of earth worms in the United States, but it is a matter of common experience that such worms, together with soft grubs, etc., are found in abundance only in comparatively moist and light ground. Hence, we may conclude that if moles are not as a rule found in arid regions, it is chiefly, and perhaps solely, because sufficient food is unobtainable in such places. If moles are not found in the hot Sacramento Valley, as appears to be the case, and in the arid portions of southern California, it is not on account of the high temperature, but of the aridity, which causes the lack of an abundant food supply.[1] The western limitation of *Scalops* and the southern limitation of *Scapanus*, as well as the peculiar features of the distribution of the latter genus, are illustrations, in my opinion, of this proposition.

As regards the limitation of the several genera toward the north, the case is different. The western genera *Scapanus* and *Neürotrichus*, so far as known, stop at the Fraser River, British Columbia. In the east, *Scalops* stops at the northern boundary of the warm temperate subregion (except in the Alleghanies, as already explained), while *Condylura* reaches to Hudson Bay. *Parascalops*, as far as known, goes northward only to Maine.

In the case of *Parascalops*, it is perhaps useless to attempt any explanation, as the amount of material at command has been small, and the apparently limited range may be much extended by subsequent researches. At all events, as the genus *Condylura* reaches much farther north, it will not be allowable to hold that *Parascalops* is limited northward by lack of food supply, and there is certainly no lack of humidity.[2]

In the case of the western genera, likewise, there are no known peculiarities of food supply or humidity at the northern limit, as for example at the Fraser River, which can be evoked to explain the termination of the range at this point.

In explanation of the northern limitation of the several genera, therefore, we probably can not do better than to make use of Merriam's theory, which is that "the northward distribution of animals and plants is determined by the total quantity of heat, the sum total of effective temperatures."[3] This implies that the several species of moles can not reproduce their kind at more northerly points for want of a sufficient amount of heat during the year. This theory does not, of course, explain why different species require a varying total of heat, some more and some less. Furthermore, it does not take into consideration the direct effect of cold on animals, nor the effects of accumulated snow,

[1]Eisen has described earthworms from Fresno, but whether from garden spots or the open fields I do not know.

[2]I have taken an earthworm out of the stomach of a star-nosed mole from Moose Factory, Hudson Bay territory, so that there can be no question that these worms occur there.

[3]Nat. Geog. Mag., VI, p. 236.

nor the ability or inability of different mammals to hibernate. Nevertheless, Dr. Merriam has shown that a relation exists between faunal areas which have been recognized for a long time, and the total amount of heat in those areas, and his theory is therefore deserving of serious consideration.

A feature in the distribution of the northern genera which merits attention is their failure to cover the entire areas which on theoretical grounds are suitable for them. Why does not *Condylura* occupy British America generally, the northern Rocky Mountains, etc.? Why does *Parascalops* stop in eastern Ohio instead of accompanying *Condylura* westward to Minnesota? Why does not *Neürotrichus* occupy the mountain ranges of southern California with *Scapanus*, and why do not these two genera spread out eastward over the northern Rocky Mountains? I appreciate the fact that subsequent researches may show that these genera really do have a more extensive range than is now indicated, but in the present state of knowledge these peculiarities of distribution remain unexplained. It is improbable that in all cases the range will be hereafter shown to be greatly extended.

As regards *Scalops*, there is no temperature barrier to prevent its extension across the Plains, and even to the Pacific Coast. That it falls short is evidently due, as already insisted upon, to the condition of the environment as regards humidity.

DENTITION.

The formulæ for the dentition of the American genera of moles are given by Dobson as follows:

Condylura, i, $\frac{3}{3}$; c, $\frac{1}{1}$; pm, $\frac{4}{4}$; m, $\frac{3}{3}$.
Scapanus, i, $\frac{3}{3}$; c, $\frac{1}{1}$; pm, $\frac{4}{4}$; m, $\frac{3}{3}$.
Scalops, i, $\frac{3}{2}$; c, $\frac{1}{0}$; pm, $\frac{3}{3}$; m, $\frac{3}{3}$.
Neürotrichus, i, $\frac{3}{3}$; c, $\frac{1}{1}$; pm, $\frac{3}{2}$; m, $\frac{3}{3}$.

In the large series of skulls to which I have had access, are several of each genus sufficiently young to show the milk dentition and the sutures between the various bones. A study of these specimens leads to some rather interesting results. I find that formulæ based on the position of the suture between the premaxilla and the maxilla deviate in some instances from those given above. If the position of the suture must be rigidly considered in identifying the canine, some formulæ now in current use must be abandoned. A similar dilemma seems to have been met with in connection with the European genus *Talpa*, for Professor Flower remarks, in Mammals Living and Extinct (p. 23):

> It happens conveniently for our purpose that in the great majority of cases the segmentation of the (maxillary) bone coincides with the interspace between the third and fourth tooth of the series; still when it does not happen to do so, as in the case of the mole, we must not give too much weight to this fact, if it contravenes other reasons for determining the homologies of the teeth.

Now, it so happens that in *Scapanus* and *Parascalops* the position

of the suture is such that if used exclusively in determining the homology of the teeth, as already stated, very different formulæ from those ordinarily accepted are obtained. Accepting Professor Flower's dictum, what reason is there for ignoring the position of the suture? The reason is this: It is a well-known fact that in most placental mammals the first premolar is without a milk predecessor. If, therefore, we find a tooth close to the intermaxillary suture, which is without a predecessor, we may conclude that this tooth is the first premolar. We may expect to find also a corresponding tooth in the lower jaw.

In examining carefully the young skulls already mentioned, I find this first premolar in many cases without difficulty and with certainty, and I will now proceed to give conjointly the formulæ obtained by employing the two methods of determination.

For *Scapanus* we have the following:

Formula by premolar: i, $\frac{3}{4}$; c, $\frac{1}{1}$; pm, $\frac{4}{4}$; m, $\frac{3}{3}$.
Formula by suture: i, $\frac{2}{2}$; c, $\frac{1}{1}$; pm, $\frac{5}{5}$; m, $\frac{3}{3}$.

In this genus, as will be observed, the intermaxillary suture comes between the second and third anterior teeth, and if employed in identifying the teeth, gives the genus but two incisors on each side. The formula based on the first premolar is more in harmony with general considerations.[1]

The genus *Parascalops* gives exactly the same results as *Scapanus*, though the material in this case is hardly as satisfactory.

The genus *Scalops* gives the following results:

Formula by premolar: i, $\frac{3}{3}$; c, $\frac{1}{1}$; pm, $\frac{3}{3}$; m, $\frac{3}{3}$.
Formula by suture: i, $\frac{3}{3}$; c, $\frac{1}{1}$; pm, $\frac{3}{3}$; m, $\frac{3}{3}$.

In this genus there is no difference in the formula whether based on the position of the suture or on the premolar. A more important matter here is the question of the presence of a third lower incisor and lower canine. The formula as given by Mivart, Dobson, and others is i, $\frac{3}{2}$; c, $\frac{1}{0}$. But I find that in young skulls there are two small teeth behind the second lower incisor, and what is considered to be the first premolar. While these are like milk teeth in their simple form, their position would appear to indicate that they do not belong to the milk dentition, but to the permanent dentition. From the reduction of the jaw they have become minute, and disappear before full growth is attained. In the discussion of individual variation in the genus *Scalops* (p. 37) I shall show that youngish skulls of this genus often present at least a rudiment of the posterior of these two minute teeth and occasionally a well-developed tooth. It appears probable, therefore, that in the lower jaw a reduction of the third and fourth teeth has taken place, similar to that which has affected the second and third teeth of the upper jaw, but the process has been carried further. It

[1] *Scapanus anthonyi* is here left out of consideration, as it is based on a single adult specimen.

may be remarked that the minute teeth of the upper jaw have milk predecessors.

In view of what has just been stated, the formula, i, $\frac{3}{3}$; c, $\frac{1}{1}$, ought to be used in comparative tables for the permanent dentition, but, of course, with the explanation that the formula i, $\frac{3}{2}$, c, $\frac{1}{0}$ represents the functional dentition, so far as incisors and canines are concerned.

In the case of the genus *Condylura* the material at command is insufficient. None of the young skulls have more than a small part of the milk dentition, and they are also broken in such a manner as to defeat critical examination. In skull No. 2094, Bangs' collection, the fourth upper tooth stands in the suture and may be recorded as a canine. The formula, according to the suture, therefore, would be i, $\frac{3}{3}$; c, $\frac{1}{1}$; pm, $\frac{4}{4}$; m, $\frac{3}{3}$, which must be accepted at least until the full milk dentition can be examined.

In the genus *Neürotrichus* there is no tooth in the series anterior to the molars which has not a milk predecessor. There are three teeth in each side of the premaxillary bone, and in the suture appears a large fourth tooth, which must be reckoned as a canine. The milk predecessor of this tooth stands behind it quite independently, the large tooth pointing backward and the small one forward. The two teeth which come next have milk predecessors implanted over them. Thus it appears that there is no premolar without a predecessor. It is only natural to suppose that the first premolar is absent and that those which are present are the second and third. Allowing this to be the case, we have, deciding by the suture, the following formula: i, $\frac{3}{3}$; c, $\frac{1}{1}$; pm, $\frac{2}{2}$; m, $\frac{3}{3}$.

This is the same as the formula adopted by Dobson.

To summarize, the formulæ of the different genera are as follows:

Scalops, i, $\frac{3}{4}$[1]; c, $\frac{1}{1}$[1]; pm, $\frac{3}{3}$; m, $\frac{3}{3}$.
Scapanus, i, $\frac{3}{3}$; c, $\frac{1}{1}$; pm, $\frac{4}{4}$; m, $\frac{3}{3}$.
Parascalops, i, $\frac{3}{3}$; c, $\frac{1}{1}$; pm, $\frac{4}{4}$; m, $\frac{3}{3}$.
Condylura, i, $\frac{3}{3}$; c, $\frac{1}{1}$; pm, $\frac{4}{4}$; m, $\frac{3}{3}$.
Neurotrichus, i, $\frac{3}{3}$; c, $\frac{1}{1}$; pm, $\frac{2}{2}$; m, $\frac{3}{3}$.

COLOR OF MOLES.

The color variations of moles are of much interest, as the style of coloration is of the simplest character, and the complexity caused by the appearance or disappearance of spots, lines, etc., is absent. The various species belonging to the several genera do not exhibit the same degree of variation, *Parascalops*, *Condylura*, and *Neürotrichus* exhibiting but little, *Scapanus* a moderate amount, and *Scalops* more.

The variations of *Scalops* are geographical, the main departure from the mean of coloration being in the Northwest and Southwest. In the Mississippi Valley generally, but particularly in southern Minnesota and Wisconsin, there is a tendency to increase in pallor, producing a

[1] Persistent canines and incisors = i, $\frac{3}{2}$; c, $\frac{1}{0}$.

general silveriness of coloration. In southwestern Texas the color assumes more or less of a buff tint, sometimes quite pale and clear and very striking.

This alteration, so far as I am able to judge, has nothing directly to do with the color of the soil. The change in Illinois and the surrounding parts of the Mississippi Valley should be toward black, if the object were to reach a coloration in harmony with that of the soil, whereas whatever change is perceptible is in the opposite direction. The alteration in the Northwest and Southwest likewise is apparently due to the comparative aridity of the regions, the color of the Texan form being different from that of the Northwest, because the parent form is somewhat different in color in the two cases.

On the west coast, as on the east, the change of color is chiefly one of intensity, and runs parallel with the increase or decrease of humidity, as is the case with so many of our mammals. The changes here in *Scapanus*, taken as a whole, are much more striking than those in *Scalops* of the East. In the region of great precipitation, in western Washington and Oregon, the moles are nearly black. In northern California the color is lighter and browner, and in southern California tends to silvery tints. Here again, as far as my observations go, the color of the soil has little to do directly with that of the moles. A soil is, of course, darker when wet than when dry, but the soil about Puget Sound is not especially dark, and certainly does not correspond with the dusky appearance of the moles.

Possibly we should not expect to find any correspondence, for while the mole is in its burrow its color or that of the soil can be of little consequence.

We appear to have in the varying intensity of color in moles a purely physiological phenomenon connected with humidity and light. Exactly how humidity affects color is not evident, though there can be little doubt of the fact. So far as I have observed, recent writers, as for example Beddard or Poulton, do not offer any explanation of this phenomenon, though aware of its occurrence.

It has to be remembered in this connection that *Neürotrichus*, which is found with *Scapanus* and *Parascalops*, and *Condylura*, which are found with *Scalops*, do not change in color in any marked degree.

VARIATION IN SIZE.

It is noticeable that in the genera having the smallest range and the least variation in color, the variation in size is also at a minimum. In *Condylura*, *Parascalops*, and *Neürotrichus* there is little variation, while in *Scalops* and *Scapanus* it is marked. In the case of the last two genera, the smallest representatives scarcely exceed one-half the length of the largest.

So far as the causes of this variation are apparent, they have to do with the food supply. In the case of *Scalops*, the variation is exceedingly gradual on the Atlantic Coast, the size decreasing from north to

south, as is the case with so many other North American mammals. West of the Alleghanies, however, *Scalops* maintains large size over a wide area, without regard to latitude. On the west coast, *Scapanus californicus* decreases gradually in size from north to south, as does *Scalops* on the east coast.

In cases where the conditions are simple, size may be supposed to depend upon the amount of energy expended in obtaining a given amount of food.[1] This relation would at first affect the individual, and finally the race.

A light, moist, fertile soil would contain the greatest number of earthworms and beetles and be most easily worked; hence the moles would be large.

Where the soil was dry and hard, worms and insects would be fewer and the exertion of finding them great; here we should expect to find small moles.[2]

As we have shown above, these anticipations are fulfilled in the different parts of the range of *Scalops* and *Scapanus*.

One feature of the moles as regards size remains to be mentioned. The largest moles are found at the northern boundary of the range in the case of *Scalops* and *Scapanus*. There is no gradual diminution as the limit is reached.[3]

It is not entirely clear what is the cause of this phenomenon. We might suppose, in accordance with the terms of Dr. Merriam's theory, that although food was most plentiful near the northern limit, and hence size large, a point was suddenly reached where the total amount of heat was insufficient for reproduction, and the moles, though abundantly nourished, ceased to propagate. This at first would seem to be a satisfactory explanation; but that it does not really explain the matter will appear from a consideration of the effect of cold on plants. The willows, which are goodly trees in the temperate zone, grow smaller and smaller northward, till in the Arctic they are dwarfed to such an extent that they will rise only a few inches above the ground, or even trail along it like a vine; yet they flower profusely and their catkins are of a very large size. We might expect to find something analogous in connnection with the moles, but, as we have seen, quite the reverse occurs. They cease when their size is at a maximum.

[1] "The available supply of assimilable matter being the same, and other conditions not dissimilar, the degree of growth varies according to the surplus of nutrition over expenditure—a generalization which is illustrated in some of the broader contrasts between different divisions of organisms, and is a direct corollary from the resistance of force." Spencer, Principles of Biology, I, 1881, p. 131.

[2] In this connection it may be interesting to note the fact that in the hard clay soil of the District of Columbia I find that the earthworms are collected in summer in colonies under stones or cow dung, leaving large areas unoccupied, through which a mole might tunnel in vain, expending a large amount of energy, with no return.

[3] Leaving out of consideration the small *Scapanus orarius* which lives with the large *Scapanus townsendi* at the northern part of its range, but does not appear to intergrade with it.

Some considerations of a different character may throw light on the problem as far as concerns *Scalops*. It will be noticed upon examination of forestry maps of North America[1] that the coniferous forest terminates on the south at the exact point where the moles reach their northern limit. It would appear as if these forests prevented the further northward distribution of *Scalops*. This is not at all improbable, though it is likely that their effect is indirect rather than direct. Adopting this view, we may look upon *Scalops* as a northern genus whose proper northern extension has been reduced by the growth of coniferous forests.[2] As the whole family *Talpidæ* is of northern origin so far as known, this view is perhaps not without force.

Family TALPIDÆ.

Diagnosis.—Small insectivora. Humerus articulating with both scapula and clavicle. Clavicles reduced in length. An elongated manubrium sterni. Acetabula closely approximated. Eyes minute. No ear-conch (except in *Uropsilus*). Molars three on each side of either jaw; incisors not exceeding four; premolars not exceeding four. Molars broad, with W-shaped external cusps, and an internal basal ledge.

Zygomatic arches complete. Tympanic bullæ more or less complete. Lumbar vertebræ with hypapophysial ossicles. No symphysis pubis.

The first paragraph of this diagnosis contains all the characters by which this family can be clearly separated from the other families of the order. The typical moles, such as *Talpa*, *Scalops*, etc., are, of course, readily separable, from the representatives of other families, but many of the distinctions break down in such forms as *Neürotrichus*, *Uropsilus*, etc.

Thus, the radial sesamoid, characteristic of the manus of the typical moles, is absent in *Urotrichus*, *Uropsilus*, etc. An ear-conch, which is absent in the typical moles, is present in *Uropsilus*.

Many characters which are sufficiently diagnostic in combination are, nevertheless, shared by the representatives of other families. Thus, the peculiar hypapophysial ossicles of the lumbar vertebræ occur also in the *Erinaceidæ*.[3] Complete zygomatic arches occur in *Chrysochloridæ* and *Erinaceidæ* as well as in the moles. The *Chrysochloridæ* and *Potamogalidæ*, like the moles, are without true symphysis pubis.

The moles are on the whole more nearly related to the shrews than to any other insectivores, and the more aberrant forms, like *Urotrichus* and *Uropsilus*, bear a strong external resemblance to the shrews. Still there are no moles without zygomatic arches and none with the long-

[1] See Forestry Report, Tenth Census, by Sargent.

[2] It is a singular fact that where the coniferous trees are cut down, as, for example, in Alaska, they are replaced by deciduous trees. When the woodman's ax has passed over the Alaskan forests, therefore, we may expect to find that territory covered by deciduous trees.

[3] What is more remarkable these ossicles occur also in *Perameles*, a marsupial mammal.

crowned incisors of the shrews. In this latter character *Condylura* shows, perhaps, the nearest approach to the shrews, but it is nevertheless a true mole.

Genus SCALOPS Cuvier, Illiger.

Scalops, CUVIER, Leçons d'Anat. Comp., I, 1800 (Tableau Gén. Classif. Anim.). (No description or type.)

"*Scalops*, Cuvier." ILLIGER, Prodromus Syst. Mamm. et Avium., 1811, p. 126. Type: *Sorex aquaticus*, Linnæus.

Talpasorex, LESSON, Manuel de Mammalogie, 1827, p. 124. Based on Harlan's *Scalops pennsylvanica*. (Not *Talpasorex*, SCHINZ.)

Skull with marked interorbital constriction. Palate extending back behind the last molars. Tympanic bullæ complete. Pelvis with two bony bridges connecting the sacral vertebræ with the ischium. Functional dentition: i, $\frac{3}{2}$; c, $\frac{1}{0}$; pm, $\frac{3}{3}$; m, $\frac{3}{3}$. First upper incisor very large; second and third minute. Molars with a narrow, simple anterior internal basal ledge. Nostrils simple, superior. Fore and hind toes webbed. Manus with an *os falciforme*.

This genus was the first of the American forms to be separated from the comprehensive Old World genus *Talpa*. Though given a name in 1800 by Cuvier, it was not really characterized until 1811, when Illiger gave a diagnosis and specified a type. It has been generally considered as not nearly allied to the Pacific Coast genus *Scapanus*, on account of the differences in dentition. I have found, however, that these differences are not so great as has been supposed, while on the other hand the skeleton and skull present very great similarities in contrast with the genus *Parascalops*.

The genus is distinguishable by external characters, of which the principal are the webbed condition of the forefeet and the superior position of the nostrils.

SCALOPS AQUATICUS (Linnæus).

EASTERN MOLE.

Sorex aquaticus, LINNÆUS, Syst. Nat., 10th ed., 1758, p. 53.

Talpa europæa flarescens, ERXLEBEN, Syst. Reg. Anim., 1777, p. 118.

Talpa europæa, flara, GMELIN, Linn. Syst. Nat., 1788, p. 110.

Talpa flara, KERR, Anim. King., 1792, p. 201.

Talpa fusca, KERR, Anim. King., 1792, p. 202; SHAW, Gen'l Zool., I, 1800, p. 524.

Scalops canadensis, DESMAREST, Mammalogie, 1 part., 1820, p. 155.—HARLAN, Fauna Amer., 1825, p. 32.

Scalops pennsylvanica, HARLAN, Fauna Amer., 1825, p. 33.

Scalops aquaticus, F. CUVIER, Dents des Mamm., 1825, p. 251, No. 22.—FISCHER, Synop. Mamm., 1829, p. 249.

Talpa (*Scalops*) *Virginiana*, DE BLAINVILLE, Osteographie, Atlas, I, 1839–1864, table des planches, p. 4; Insectivores, pl. V (skull), pl. IX (teeth).

Talpa pennantii, LE CONTE, Proc. Acad. Nat. Sci. Phila., VI, 1853, p. 327.

Talpa aquatica, LE CONTE, Proc. Acad. Nat. Sci. Phila., VI, 1853, p. 327.

Talpa cupreata, RAFINESQUE, Precis des decouv. et travaux somiologiques, Palerme, 1814, p. 14.

"Purple species," HARRIS, New England Farmer. [Fide LE CONTE.]

Diagnosis of species.—Snout simple, depressed; naked above as far back as the line of the anterior incisors. Nostrils simple, superior, with two minute papilliform processes within. Eye and auditory orifice minute and concealed in the fur. Palm as long as the sole, but two and one-half times as broad. Tail short, slender, and terete; the proximal third clothed with long hair like that of the body, and the remainder with sparse, short hairs. Color brownish gray, varying to silvery gray and to creamy buff. Hairs of feet and tail white.

KEY TO SUBSPECIES OF SCALOPS AQUATICUS.

a. Size medium (average total length 162 mm.). Color shining gray-brown. *typicus*, p. 20.

b. Size very small (average total length 142 mm.). Hind foot long. Tail short. Color as in *a*. Skull and teeth delicate; coronoid process slender, uncinate. *australis*, p. 21.

c. Size very large (average total length 190 mm.). Tail and hind feet long. Color inclining to silvery. Skull massive; molars large and quadrate; coronoid process triangular ..... *machrinus*, p. 20.

d. Size very small, as in *australis* (average total length 139 mm.). Wrists and base of snout in males bright rusty orange. Skull and teeth massive, frontal sinuses enlarged; coronoid process stout ..... *texanus*, p. 21.

DIAGNOSES OF SUBSPECIES.

SCALOPS AQUATICUS TYPICUS.

EASTERN MOLE.

Diagnosis.—Average total length, 162 mm.; tail one-sixth of the same, and hind foot one-eighth; dentition moderate; coronoid process of mandible heavy, scarcely uncinate, with a more or less distinct mammiform tubercle on the posterior margin; color nearly uniform shining grayish hair-brown; grayer and more silvery below; all the fur of the body plumbeous at the base; hairs of the feet and tail white.

SCALOPS AQUATICUS MACHRINUS (Rafinesque).

PRAIRIE MOLE.

Talpa machrina, RAFINESQUE, Atlantic Journal, 1832, p. 61.

Talpa sericea, RAFINESQUE, Atlantic Journal, 1832, p. 61 (Young).

Scalops argentatus, AUDUBON & BACHMAN, Journ. Acad. Nat. Sci. Phila., VIII, 1842, p. 292.

Scalops aquaticus argentatus, COUES, Bull. U. S. Geol. and Geog. Survey Terr., III, No. 3, 1877, p. 633.

? *Talpa Pennantii*, LE CONTE, Proc. Acad. Nat. Sci. Phila., VI, 1853, p. 327.

Diagnosis.—Size the maximum for the species. Total length, average, 188.7 mm.; skull, average, 37.1 mm. Tail and hind foot proportionally longer than in the typical form. Teeth large. Coronoid process of mandible triangular, large, with usually a straight posterior margin. Color as in the typical form, or a little paler.

Average dimensions from fresh specimens (6 from Illinois): Length of head and body, 154.9 mm.; tail vertebræ, 33.8 mm. Average dimen-

sion from alcoholic specimens: Total length, 131.3 mm.; head, 49.2 mm.; tail vertebræ, 31.2 mm.; hind foot (without claw), 19.8 mm. Average dimensions of skull (13 from Illinois, Missouri, and Kansas): Total length, 36.8 mm.; greatest breadth, 19.6 mm.; palate length from inside of incisors, 16.5 mm.

Type-locality.—Near Lexington, Kentucky.

Distribution.—Mississippi Valley, from Tennessee and Missouri northward to Wisconsin and Minnesota, and westward to eastern Kansas and Nebraska and southwestern South Dakota. Manitoba (?).

SCALOPS AQUATICUS AUSTRALIS, Chapman.

FLORIDA MOLE.

Scalops aquaticus australis, CHAPMAN, Bull. Amer. Mus. Nat. Hist., V, 1893, 339.
? *Scalops parvus*, RHOADS, Proc. Acad. Nat. Sci. Phila., 1894, p. 157.
? *Talpa cupreata*, RAFINESQUE, Precis des découvertes et trav. Somiologiques, 1814, p. 14.

Diagnosis.—Size much smaller than in the typical form (average total length 142 mm.) and hind foot proportionately long; skull small; teeth delicate; coronoid process slender, uncinate, without a secondary process on the posterior margin; color brownish silvery gray, as in the typical form, but often with rusty spots on the sides of the nose and about the chin and wrists.

Average dimensions.—(9 fresh specimens, males, from Oak Lodge, opp. Micco, Florida; Bangs' Coll.): Total length, 137 mm.; tail, 20.6 mm.; hind foot, 17.1 mm. Alcoholic specimens: Total length, 123 mm.; head, 40.1 mm.; tail vertebræ, 23.4 mm.; hind foot (without claw), 15.1 mm.

Average dimensions of adult skulls (9 males from Oak Lodge, Florida): Total length, 30.8 mm.; greatest breadth, 16.2 mm.; length of palate from inside of incisors, 13.1 mm.

Type-locality.—Gainesville, Florida.

Distribution.—Eastern Florida, south to Lake Worth and Orange Hammock (De Soto County). Western Florida, Tarpon Springs.

SCALOPS AQUATICUS TEXANUS (J. A. Allen).

TEXAS MOLE.

Scalops argentatus texanus, J. A. ALLEN, Bull. Amer. Mus. Nat. Hist., III, 1891, p. 221.
Scalops texanus, J. A. ALLEN, Bull. Amer. Mus. Nat. Hist., V, 1893, p. 200.

Diagnosis.—Size small, as in subspecies *australis* (average total length of males 141 mm.). General coloration as in the typical form, but strongly suffused on the forehead, chin, breast, and wrists with rusty orange-brown.

Skull small, massive. Frontal sinuses enlarged. Mandible deep; coronoid process broad, with a straight posterior margin. Molar teeth large. First upper premolar small.

Average dimensions of fresh specimens (from J. A. Allen): Male, total length, 141 mm.; tail, 25 mm.; hind foot, 17.8 mm. Female, total length, 137 mm.; tail, 23 mm.; hind foot, 16.5 mm.

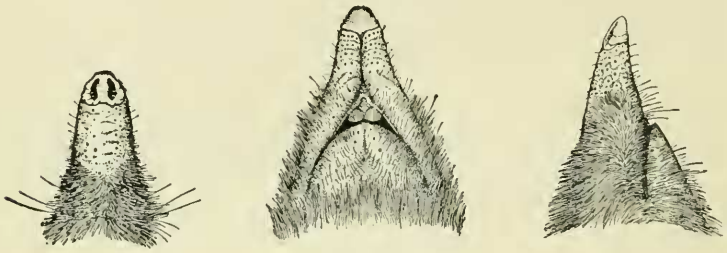
Average dimensions of skull (10): Total length, 30.9 mm.; greatest breadth, 16.7 mm.; length of superior tooth row, 13.9 mm.

Type-locality.—Given by Dr. J. A. Allen as Presidio County, Texas, but believed to be Aransas County.

Distribution.—Coast of Texas.

DESCRIPTION OF SPECIES.

Body fusiform. Fore legs enveloped in the integument of the body as far as the wrists, and the hind legs to the middle of the tibiæ. Palm



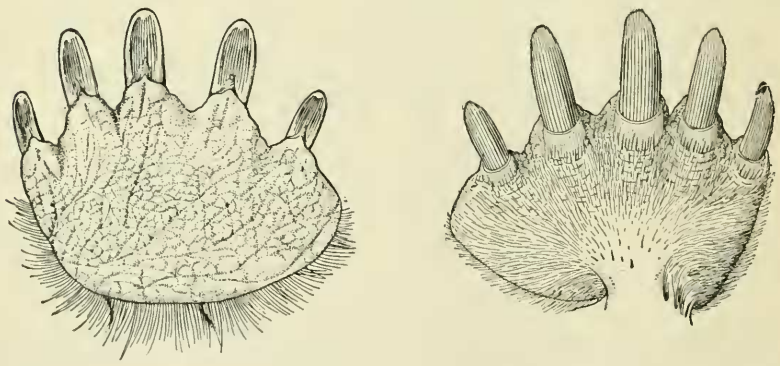
4. 5. 6.

SNOUT OF SCALOPS AQUATICUS.

Fig. 4, Upper surface. Fig. 5, Lower surface. Fig. 6, Side view.

(One and one-third times natural size.)

equal to the sole in length, but two and a half times as broad as the latter. Snout moderately elongated (extending in adults about 10 mm. beyond the upper incisors), depressed, naked on top as far back as the line of the anterior incisors. Nostrils superior, about 2 mm. long,



7. 8.

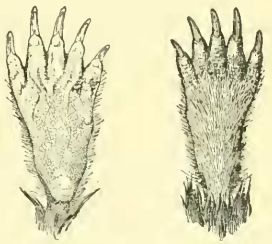
FORE FOOT OF SCALOPS AQUATICUS.

Fig. 7, Lower surface. Fig. 8, Upper surface.

crescentic, close to each other and to the extremity of the snout anteriorly; each bearing two cilia within. Corner of the mouth slightly anterior to the line of the eyes. Upper lip with a narrow ridge on each side.

Eyes minute, but not covered by membrane. No external ears. The auditory orifice (entirely concealed in the fur) minute, circular, situated slightly below the level of the eye and on a line with back of the wrist.

Fore feet very large, broader than long (exclusive of the claws). The palms directed backward, and can not be applied to the ground in walking. Palms as long as the soles, but two and a half times as broad as the latter. Fore toes webbed to the base of the nails, which are long, broad, and depressed, and convex above. Back of the manus covered with short, soft, white hairs, which form a fringe all about the margin. Last joint of the toes naked. Palms naked, with very numerous irregular furrows. Second, third, and fourth digits subequal; fifth a little shorter; pollex still shorter and in a line with the other toes



9. 10.

HIND FOOT OF SCALOPS AQUATICUS.
Fig. 9, Lower surface. Fig. 10, Upper surface.

Hind feet small and narrow, with long, slender, sharp little-curved claws; otherwise like the fore feet.

Tail short, slender, terete, tapering. The proximal third clothed with long hair, like that of the body; but the remainder with rather short and sparse hairs, which do not conceal the skin; a short terminal pencil.

11.
TAIL OF SCALOPS AQUATICUS.
(Natural size.)

Fur very fine, velvety, slightly crenulate, and with broad, shining tips.

General color of the body everywhere nearly uniform shining silvery gray, tinged more or less with brown, varying (in subspecies *texanus*) to pale brown or cream color. Hairs dark plumbeous, except at the extremities. Those on the back of the feet, on the tail, and lower jaw dull white to the base. On the forehead and around the eyes and wrists similar, varying (especially in subspecies *texanus*) to strong rust color.[1]

SKULL.

Skull oval, depressed. Facial portion cylindrical, only slightly sloping from the forehead forward. Anterior nares opening forward. Premaxillæ extending beyond the nasals anteriorly. Nasals triangular,

[1]It may be of interest to note here that parasites are sometimes found on our moles. Two different forms were found on a *Scalops* from Brightwood, D. C., regarding which Mr. Linnell, of the Department of Insects, National Museum, has kindly sent me the following facts:

"The specimens found on a live mole that you sent are as follows:

"1. *Leptinus testaceus* Müll.; a blind beetle, allied to the Beaver louse (*Platypsylla*), found with various small rodents and insectivora, either on their bodies or in their nests. Europe and America.

"2. *Pulex* sp. The species of this group are not worked out yet."

elongated. Zygomatic arch slender, ascending posteriorly. Infraorbital foramen large, oblique. Interorbital area inflated. Parietals broad, triangular, with a concave posterior margin; mastoid and occipital borders equal, mastoids inflated. Foramen magnum high and narrow. Tympanic bullæ complete, rounded, depressed; meatus auditorius externus small. Palate long, moderately concave, with a prominent transverse posterior margin.

Mandible with stout horizontal ramus; ascending ramus very short, and directed backward. Coronoid broad, triangular, and erect; angular process large, oblong, with a rounded margin posteriorly, and concave superior margin. Condyles long, cylindrical, transverse.

TEETH.

Functional dentition: i, $\frac{3}{2}$; c, $\frac{1}{0}$; pm, $\frac{3}{3}$; m, $\frac{3}{3}$; total, 36.

First upper incisors large and long, obtusely pointed, somewhat divergent, convex in front, flat behind. Second and third incisors minute, slender and simple. Canine two-thirds as long as the first incisor, cuspidate. First premolar less than half the size of the canine, simple, unicuspidate. Second and third premolars successively larger, unicuspidate, with a compressed, trenchant posterior margin terminating below in a tubercle. The third with a very small heel (disappearing with age). Molars W-shaped in transverse section with a large V-shaped, antero-internal heel or cusp; first and second subequal and quadrate. Second molar with four external, two internal, and one basal cusp. First and third molars with three external, two internal, and one basal cusp.

First lower incisor small, unicuspidate; second large, elongate, canine-like, grooved internally. Premolars increasing in size from the first to the third; the latter as long as and considerably thicker than the second incisor. The posterior edges of the premolars rather trenchant. Molars W-shaped in transverse section, each with two external and three internal cusps. First and second molars subequal and largest; third smaller.

SKELETON.

The vertebral formula of *Scalops* is given by Cuvier and by Bell as follows: c, 7; d, 12; l, 7; s, 6; ca, 10; total 42. I find by examination of skeletons in the National Museum collection that the normal formula is c, 7; d, 14; l, 5; s, 6; ca, 11; total, 43. One skeleton, while preserving the same number of lumbars, has 15 dorsals, making the total number of vertebræ 44. There are 7 intervertebral ossicles, arranged as in *Scapanus*. The sternum consists of 6 segments and a very large manubrium, which is exactly as long as the combined segments. The first pair of ribs joins the manubrium near the junction of its third and last fourth. The ribs are broad and flat. The upper surface of the manubrium is dilated and grooved, with incurved raised edges.

The keel is triangular, deepest in front.

The clavicles are only two-thirds as long as broad, and are pierced by a foramen. The scapula is very narrow, with high ridges. The acromion is low and long.

The humerus is only a fifth longer than broad.

The pelvis is very narrow, and the bones of the opposite sides are in contact under the acetabulum. The space between the sacral vertebræ and pelvis is entirely covered over above by osseous bridges, leaving only two pairs of small foramina.

The femur is three-fourths as long as the tibia.

The *os falciforme* is long and slender, slightly tapering and curved at the base. The tip reaches to the base of the terminal phalange of the fifth digit.

The terminal phalanges are bifid.

GEOGRAPHICAL DISTRIBUTION.

The area occupied by the genus *Scalops*, as shown by specimens examined in the preparation of this monograph, has the following boundaries: The northern boundary passes through central Massachusetts and central New York to Lakes Ontario and Erie, thence westward to the southern extremity of Lake Michigan, thence in a northwesterly direction across southern Wisconsin to Elk River, Minnesota, and thence southwestward to the mouth of the Big Sioux River, in South Dakota.

The western boundary follows in a general way the ninety-seventh parallel and thus includes the eastern fourth of Nebraska, Kansas, and Indian Territory. Continuing in Texas it bends somewhat to the west and follows the ninety-ninth parallel, terminating in Tamaulipas, about 45 miles south of the Rio Grande.

The southern boundary is the Gulf of Mexico, and in Florida a line connecting Tampa Bay on the west side with Lake Worth on the east.

An examination of numerous faunal records shows that it is necessary to somewhat extend the range as derived from specimens. In the Northeast, for example, the boundaries should include all Massachusetts, on the authority of Dr. J. A. Allen[1] and Emmons,[2] and some part at least of Vermont, on the authority of Thompson.[3] As regards its absence in northern New York, Baird remarks that *Parascalops breweri* is found here "apparently to the exclusion of the more southern species with white naked tail, *S. aquaticus*."[4] I have not met with any record of the occurrence of *Scalops* in New Hampshire. Mr. G. S. Miller, jr. does not include it among the mammals observed by him in the White Mountain region. If there are records of its occurrence in Maine, they have escaped my attention. While in Hancock County in the summer of 1894, I was informed that the mole was found there, but not abundantly. I did not see any evidences of its presence, however, and

[1] Bull. Mus. Comp. Zool., I, 1869, p. 221.

[2] Emmons, Quadrupeds of Mass., 1840, p. 15.

[3] Thompson's Vermont, p. 27.

[4] Fifteenth Rept. State Cab., Nat. Hist., 1862. App. A.

certain runways which were pointed out to me as those of the mole I proved afterwards to be made by meadow mice.

The records relating to Canada are rather conflicting, but there is probably little doubt of the occurrence of the genus in the southern parts. Thus, Audubon and Bachman, speaking in general terms, include Canada in the range.[1]

Couper states that *Scalops* is abundant at Montreal, and occurs also at Quebec, but is not common there.[2] Chamberlain asserts that it is common in New Brunswick,[3] and Dr. J. A. Allen mentions its supposed occurrence in the Tobique River region in this Province, but as specimens were not taken, the matter is open to question. If the mole does occur in New Brunswick, it is, of course, extremely probable that it occurs also in Maine. Gapper included the genus half a century ago in the fauna of the region between York and Lake Simcoe in Upper Canada, but no specimens were seen.[4] Mr. J. B. Tyrrell, in the Proceedings of the Canadian Institute, asserts that it is common throughout eastern Canada,[5] and another writer, in the Naturaliste Canadien, records it as existing in Canada, though it is rare.[6]

Richardson has a theory to account for the absence of the mole in high latitudes, which runs as follows:

> I do not think it [the shrew mole] can exist; at least, on the east side of the Rocky Mountains, beyond the fiftieth degree of latitude, because the earthworm on which the *Scalops*, like the common mole [*Talpa europæa*] principally feeds, is unknown in the Hudson Bay countries. (Fauna Bor. Amer., p. 11.)

Passing to the westward, the next region in which the existence of *Scalops* is questionable is southern Michigan. Miles, in 1861, includes it in the fauna of the State, but his list of mammals is probably a nominal one.[7] Hayden, in giving the range of *S. machrinus*, places the eastern limit at Detroit.[8] I have seen no specimens from the State.

In southern and central Wisconsin and Minnesota the species is known to occur. Dr. E. A. Mearns, U. S. A., collected one at Camp Douglas, in Juneau County, Wisconsin, and Strong remarks its occurrence in the southern and central sections.[9] I know of no record of its existence in northern Wisconsin.

As regards Minnesota, Prof. Otto Lugger wrote me in January, 1896, that he had obtained three specimens—one from Ottertail County, another from Anoka (Anoka County), and a third from Mankato (Blue Earth County). Ottertail County is the most northwesterly locality

[1] Quadrupeds of North America, I, p. 91.

[2] Forest and Stream, newspaper, VIII, p. 300.

[3] Bull. Nat. Hist. Soc. New Brunswick, X, 1892, p. 32.

[4] Zool. Jour., V, 1830, p. 202.

[5] Proc. Canad. Inst., 3 ser., VI, 1888, p. 88. (See Thompson's remarks on the inaccuracy of this list, and the reply, in the same journal, VII, 1889, No. 1, p. 178.)

[6] Nat. Canad., II, p. 44.

[7] Cat. of the Animals of Michigan, 1861.

[8] Trans. Amer. Phil. Soc., new ser., XII, 1863, p. 140.

[9] See Moses Strong in Geology of Wisconsin, I, 1883, p. 438.

from which the species, so far as I am aware, has been obtained. Professor Lugger, however, makes the following statement:

I have seen the undoubted work of the mole at Windom (Cottonwood County), Luverne (Rock County), and Crookston (Polk County).

The last-mentioned locality is of special interest, as it is in the extreme northwest portion of the State. As no specimens were obtained, it is not certain whether this species or the star-nosed mole is the one represented there. Professor Lugger adds:

It is frequently stated that moles are very abundant in Minnesota, yet whenever I tried to obtain specimens the "moles" turned out to be shrews.

The present species is not included by Thompson among the mammals of Manitoba.[1]

For regions west of the boundary as indicated by the specimens used in preparing this paper, there are few references to the occurrence of moles. "Though abundant on the rich bottoms along the Lower Missouri," writes Hayden, "it [*S. argentatus*] is seldom if ever seen above longitude 98 degrees. A single specimen[2] was caught near the mouth of the Big Sioux in the autumn of 1856."[3] On a preceding page he also remarks:

The *Scalops argentatus* has not yet been observed above the mouth of Big Sioux River, and it is not probable that it will be seen above the rich bottom lands which extend only to the Niobrara.[4]

Audubon and Bachman remark:

We did not see any [moles] up the Missouri River and none are found on the dry prairies of the regions immediately east of the great Rocky Mountain chain.[5]

In contradiction to this statement, we have the remark of Col. A. G. Brackett: "I have seen the tunnels of the moles in Wyoming;" and again: "I have seen their excavations on the high plains of the far West."[6]

These assertions need confirmation, as no specimens appear to have been taken, and the circumstances of the case are such as to make it improbable that the mole occurs so far west.

Another record which needs confirmation before it can be accepted is that of Hind, who remarks that on Long Creek, a tributary of the Qu'appelle River, in Assiniboine, "the burrows of moles are very numerous."[7]

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[1] Richardson refers to a mole, "species ignota," as inhabiting his "Eastern district," which extended northward from the northern shore of Lake Superior. (Fauna Bor. Amer., p. xxvi.)

[2] This is No. 1760, U.S.N.M.

[3] Trans. Amer. Phil. Soc., new ser., XII, 1863, p. 140.

[4] Op. cit., p. 139, No. 7258, U.S.N.M., collected by Dr. Hayden, is from the "Sand Hills, Nebraska," but the catalogue does not specify from how far west.

[5] Quadrupeds of North America, I, p. 91.

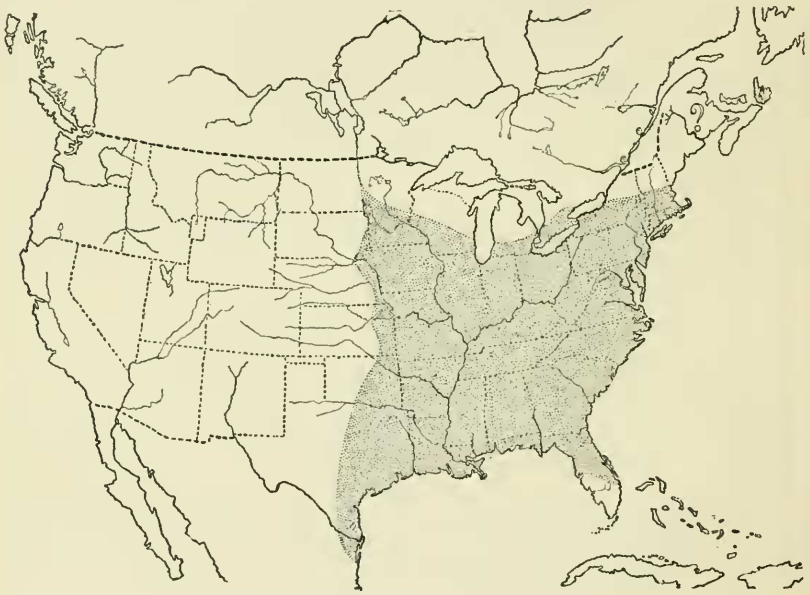
[6] American Field, newspaper, XIX, 1883, p. 130.

[7] Hind, Red River and Saskatchewan Expedition 1, 1860, 406. In this connection it is interesting to recall Richardson's theory that moles can not exist in high

A very extraordinary essay connected with this subject is that of Dr. Robert Bell on "The causes of the fertility of the land in the Canadian Northwest Territories."[1] He advances the theory that the fertility of the soil of the territory stretching northwestward from the Laird River at 60 degrees north latitude, is chiefly or entirely due to the action of moles. He remarks:

> The formation of the vegetable mold in these regions must, therefore, be due to some other agency than that of worms, and this I believe to be principally the moles, which live in vast numbers throughout the region in question. * * * There appear to be three or four different species of them.

He begins the paragraph from which the foregoing sentences are taken with the remark: "As far as I am aware, earthworms are not found in the Northwest."



GEOGRAPHICAL DISTRIBUTION OF SCALOPS.

Taking these statements in connection with others regarding food and habits, it is evident that Dr. Bell has entirely mistaken the nature of the animals he saw, being unacquainted with the appearance and habits of the mole. It seems probable that he really had to do with voles and lemmings.

The common mole is mentioned by Long[2] in the list of animals

latitudes on account of the absence of earthworms (see *ante*, p. 26). Richardson makes a further remark on this subject, as follows: "I was told by a gentleman who has for forty years superintended the cultivation of considerable pieces of ground on the banks of the Saskatchewan, that during the whole of that period he never saw an earthworm turned up." (Fauna Bor. Amer., p. 204, footnote.)

[1] Trans. Royal Soc. of Canada, I, sec. 4, p. 157.

[2] Long's Exped. to the Rocky Mts., I, 1823, p. 369.

observed in 1819 at Engineer Cantonment, which station was located near the present town of Blair, Nebraska. This locality, however, is not quite so far west as Everett (Dodge County), from which place a specimen was obtained for the collection of the Department of Agriculture.

GEOGRAPHICAL VARIATION IN SIZE AND COLOR.

The common mole varies correlatively with its geographical distribution, both in point of size and in color. Generally speaking, the largest individuals are found in the northwestern part of its range—that is, in the States bordering on the Great Lakes and the northern portion of the Mississippi Valley generally. The smallest individuals are from Florida and the Gulf coast of Texas. East of the Alleghanies there is a very uniform diminution in size from north to south, and there is a similar but less gradual diminution in the portion of the range west of the Alleghanies.

The diminution on the Atlantic Coast is well brought out by a comparison of measurements of the total length of adult skulls, as shown in the following table:

Average dimensions of adult skulls of Scalops aquaticus from different localities on the Atlantic Coast.

Locality.	Average total length.	Number of skulls.
	mm.	
Connecticut	35.5	5
New York and New Jersey	35.3	7
Pennsylvania	34.9	4
Maryland and District of Columbia	34.1	7
Virginia	33.4	3
North Carolina	31.8	9
Florida	30.8	9

The Florida specimens, representing the minimum as regards size on the Atlantic Coast, constitute the subspecies *australis* of Chapman. This form has some other characteristics, of course, besides small size, as will be found upon examining the diagnosis already given (p. 20).

On the Gulf coast about the mouth of the Mississippi and farther westward in the same latitudes in Texas and thence southward, the size is still very small, though somewhat larger than on the Atlantic Coast. The skulls of fourteen specimens from points about New Orleans, Louisiana, and thence westward to San Antonio and Mason, Texas, have an average total length of 32 mm. Included here is the form known as *S. texanus*, from Aransas County, Texas, which is practically of the same size as the Florida *S. australis*.

Seven adult skulls from Rockport, in this county, have an average total length of 30.9 mm. If we include skulls from other neighboring parts of the Texas coast (Corpus Christi, Padre Island, etc.), the average rises to 31.2 mm.

Upon passing northward from the Gulf, an increase in size above

32 mm. is found. Thus, 9 skulls from central Alabama, northern Louisiana, and central Arkansas have an average total length of 33.6 mm. It might be expected that this gradual increase would continue as we proceed northward, but such seems not to be the case. On the contrary, there appears to be a sudden increase about on the thirty-sixth parallel, skulls from Tennessee and southeastern Kansas being scarcely inferior in point of size to any in the collection. All over the Ohio and northern Mississippi valleys the largest dimensions prevail, and no correlation between size and geographical location can be traced.

The highest average in size of skulls is found in Illinois, 6 skulls from this State giving 37.3 mm. for average total length. Five skulls from Missouri give 37 mm., and two from Kansas, 36.9 mm. The largest skull in the five collections is one from Warsaw, Illinois (No. 36555 ♂), belonging to the National Museum. This has a total length of 39.8 mm.

The size of a number of these large northern skulls is given in the following table:

Catalogue number.*	Sex.	Locality.	Total length.
			mm.
N. M. 35266	.....	Madisonville, Ohio	38.0
Merr. 4264	.....	Eubanks, Ky	36.0
D. A. 46496	♂	Big Sandy, Tenn	38.6
N. M. 35211	♀	Warsaw, Ill	37.6
N. M. 35201	♀	do	36.5
N. M. 36555	♂	do	39.8
N. M. 36515	♂	Hamilton, Ill	39.0
N. M. 15398	.....	Belleville, Ill	36.0
D. A. 64225	.....	Bismarck, Mo	36.4
N. M. 1642	.....	St. Louis, Mo	35.6
N. M. 1638	.....	do	38.5
N. M. 1639	.....	do	37.5
D. A. 54097	.....	Onaga, Kans	37.7
D. A. 40407	.....	do	36.3
D. A. 43761	♀	Council Bluffs, Iowa	36.4

* In this table and throughout the paper the following abbreviations are used to denote the several collections examined:

N. M. or U. S. N. M = U. S. National Museum.

D. A. = U. S. Department of Agriculture.

A. M. = American Museum of Natural History, New York.

A. N. S. P. = Academy of Natural Sciences, Philadelphia.

Merr. = Merriam collection.

This large mole is the *machrinus* of Rafinesque, who described a specimen from near Lexington, Kentucky.[1]

The later, but more familiar, name *argentatus* of Audubon and Bachman is a synonym. The type described by these authors is said by them to have been obtained on the prairies of Michigan.[2] It is probable, however, that their specimen really came from northern Ohio, which at one time formed a part of the territory of Michigan. In another connection the authors referred to[3] speak of Erie County, Ohio, as being in Michigan.

[1] Atlantic Journal, 1832, p. 61.

[2] Journ. Acad. Nat. Sci. Phila., VIII, 1842, p. 292.

[3] Loc. cit., VIII, pt. 2, p. 203.

To sum up this discussion regarding size, it may be stated that *Scalops aquaticus* is largest in the northwestern portion of its range and somewhat smaller in the middle Atlantic States, in New York and Pennsylvania. From thence southward it gradually diminishes in size, reaching the extreme in Florida. Along the Gulf coast there is a slight increase, which is lost again in Texas, where the average is practically the same as in Florida. As the Gulf coast is departed from, there is a gradual increase in size, which becomes a sudden one about on the thirty-sixth parallel. Northward the species maintains a maximum size over a wide area.

This discussion of size has purposely been based on the size of the skull, but the size of the whole body furnishes similar indications of average increase and decrease. It is more difficult to determine how far these are illusive in the latter case, on account of the differences in the measurements of fresh specimens, made by different collectors, and the changes produced by the immersion of specimens in alcohol.

As regards color, the New York specimens are perhaps the darkest of the series before me. There is a moderate increase in pallor southward along the Atlantic Coast, but it is far from being pronounced. Specimens from Ohio, Illinois, and the northern Mississippi Valley generally are not perceptibly lighter in color than those from New York. Hence, the name *argentatus* or silvery, as applied to western *Scalops* generally, is misleading. The only quite light-colored specimens from this region, which I have examined, are two from Elk River, Minnesota, one from Council Bluffs, Iowa, and one from Camp Douglas, Wisconsin. The Minnesota specimens are distinctly silvery, and merit the name *argentatus* much more than specimens from the locality of the type in Ohio; and this is true in a still greater degree of the Wisconsin specimen. In southern Kansas the color is relatively light, and from thence southward into Oklahoma and central Texas there is a strong increase in pallor, which reaches its culmination in Padre Island, Texas, and the vicinity, where the surface color is sometimes a silvery white.

The peculiar orange-red coloration on the heads, wrists, and other parts of some specimens, especially those from the Southwest, will be considered in connection with the discussion of the subspecies which have been proposed, as this peculiarity has been mentioned in the diagnoses.

DISCUSSION OF THE NOMINAL SPECIES AND SUBSPECIES.

Among the important nominal species which I have assembled under the name of *S. aquaticus*, is the *Talpa machrina* of Rafinesque, described in 1832 from specimens from near Lexington, Kentucky. His account of it leaves no doubt that it is the mole of the Mississippi Valley, which has hitherto been recognized under the later name of *argentatus*. He described at the same time another Kentucky mole, under the name

of *Talpa sericea*, but this is quite surely the young of the preceding.[1] The *Scalops argentatus* of Audubon and Bachman[2] was described from a specimen from Erie County, Ohio. The diagnosis given is as follows:

S. Pilis tota longitudine albo plumboque annulatis, fronte mentique albido flavescente.

The annulation here spoken of I believe to be merely that produced by the regular crenulation of the hairs. The light striking on these crenulations produces the effect of alternate whitish and lead-colored rings. This appearance is not more marked in specimens from Ohio than in others. I have never seen any in which there was even an approximation to a truly ringed coloration of the hairs.

As for the color of the forehead and chin mentioned in the diagnosis, it is characteristic of the species as a whole.

In the description of this form the authors refer to its unusually large size, in which they were correct, but their remark that the fur "differs strikingly in color and luster" from that of the common mole, will not bear the test of actual comparison.

The characters which I have given on a preceding page (p. 20) are the only ones which are at all constant, and as these are relative and grade into those of the typical Atlantic Coast form, I follow Dr. Coues[3] in reducing the species to a subspecies. I make it a synonym of *Scalops aquaticus machrinus* (Rafinesque).

It may be remarked that the figure given in Audubon's folio Quad-

[1] Rafinesque's description of these two forms in the rare periodical called the Atlantic Journal is as follows:

"In 1820 I discovered two new moles in Kentucky; one is rather common, and the substitute of the common mole in the gardens. I call it talpa machrina. The other, talpa sericea, is rather scarce. A specimen was in Clifford's museum.

"1. Talpa machrina, Raf. 1820.—Long-nose mole. Fur thick, brown with grayish shades; nose elongate, depressed, naked, and tuberculate; tail one-sixth of whole length white, squared, naked; feet white.

"Total length 7 inches; tail 1¼, but only three-fourths out of the fur. Body thick, covered with soft silky fur one-half inch long, shorter and woolly on the head; nose almost like a probocis, one-half inch longer than the lower jaw, moveable, base white villose, and naked rubicund; feet naked, the anterior broad, rounded flat, with 5 toes thick and subpalmate or coherent, 5 claws nearly equal, large, convex above, flat beneath; posterior feet more slender, claws smaller, longer, and narrow. In woods, gardens, and fields, near Lexington, etc. Raises flexuose burrows of great length.

"Talpa sericea, Raf. 1820.—Silky mole. Fur short, silky, gray, with silvery shades; nose short, obtuse; tail one-fifth of whole length, cylindrical.

"Smaller than the first and more slender, only 5 inches long, body 4, and tail 1. Fur very peculiar, and different from other moles, not being reducible to different directions, but imbricate as in other quadrupeds; remainder as in the first sp. Found in woods near Nicholasville and Harrodsburg." (Atlantic Journal, 1832, p. 61.)

[2] Jour. Acad. Nat. Sci., Phila., VIII, pt. 2, 1842, p. 292 (original description.).

[3] Bull. U. S. Geol. and Geog. Survey, 1877, p. 633.

rupeds of North America[1] does not differ in color from ordinary specimens of *S. aquaticus* from New York.

Within recent years three forms of *Scalops* have been described. These are the *S. aquaticus australis* of Chapman,[2] the *S. parvus* of Rhoads,[3] and the *S. texanus* of Dr. J. A. Allen.[4] Dr. Allen's species is from the coast of Texas and the other forms are from Florida. I have not been able to determine the relationship of these forms to my entire satisfaction, chiefly owing to a lack of specimens from the southern portion of the Gulf States.

Mr. Chapman's Florida form *australis* was first described. His diagnosis includes but two characters, thus: "Similar to *Scalops aquaticus*, but averaging slightly browner and constantly much smaller."[2]

I have examined the type and several other skins and alcoholic specimens from the type locality (Gainesville) and other parts of eastern Florida. While the small size of the adults as compared with specimens from farther north on the Atlantic Coast is conspicuous, the difference in shade of color is scarcely perceptible. As regards size, I have shown in another place (p. 29) that there is a gradual diminution on the Atlantic Coast from north to south.

The skull of *australis* when first examined, seems very different from the typical form, on account of its small size and delicate structure. Perhaps the most noticeable feature is the form of the coronoid process of the mandible. This presents a real difference from that found in New York and Pennsylvania specimens. In this latter the coronoid is heavy and not strongly uncinate, and has a supplementary mammiform process on the posterior margin below the extremity. In Florida specimens the coronoid is slender and strongly uncinate and the secondary process is wanting. There is, however, a gradation in this character. In Maryland and Virginia about as many mandibles have the secondary process as are without it, and in the Carolinas it is quite rarely present.

From Mr. Chapman's comparative measurements (though he does not refer to the fact), it would appear that the hind foot is proportionately shorter in *australis* than in typical *aquaticus*.

Very careful measurements of some alcoholic specimens of adults, however, convince that the reverse is the truth, i. e., that the Florida form has the longer foot relatively, though it is, of course, absolutely shorter. The following table brings out this fact and some others in connection with proportions. I chose the proportion of the head to the tail and foot after many trials, and believe it to be reliable.

[1] Plate 150.

[2] Bull. Amer. Mus. Nat. Hist., V, 1893, p. 339.

[3] Proc. Acad. Nat. Sci. Phila. 1894, p. 157.

[4] Bull. Amer. Mus. Nat. Hist., III, 1891, p. 221.

SCALOPS AQUATICUS.

Averages and proportions (alcoholics).

No. of skulls.	Locality.	Head (average).	Tail.		Hind foot.	
			Average.	Proportion.	Average.	Proportion.
		mm.	*mm.*	*Per ct.*	*mm.*	*Per cent.*
5	Illinois and Indiana	49.2	31.2	63.4	19.8	40.0
9	District of Columbia and Virginia	45.6	26.6	58.3	16.5	36.2
8	North Carolina and South Carolina	43.0	24.2	56.3	15.8	36.7
5	Florida (east)	40.1	23.4	58.4	15.1	37.7

Some specimens of the subspecies *australis* exhibit quite strongly the rusty suffusion about the wrists, etc., which, as will presently be shown, is very pronounced in specimens from southern Texas.

The Florida *australis*, as I view the matter, is the extreme so far as the Atlantic Coast is concerned of that diminution in size and increase in delicacy of structure which one finds in passing southward from New York and Pennsylvania.

Another Florida form has been recently described by Mr. Rhoads, under the name of *Scalops parvus*.[1] It is based on a single specimen from Tarpon Springs, a locality on the west coast, just north of Tampa. It is in good condition, but the appearance of the skin and the peculiar worn state of the teeth would seem to indicate that the mole had been kept in confinement. The measurements given by Mr. Rhoads are evidently a misprint.

Of the series of external and cranial characters given by Mr. Rhoads, there are none which are not found in Carolina and central Florida specimens, except the oval shape of the foramen magnum, and this also is approached in some. The peculiar form of the last lower molar would seem to be a strong distinguishing character, but I am satisfied that it is due to the wearing away of the tooth. An examination of a series of specimens from the vicinity of Tampa Bay may confirm the validity of *S. parvus*, but on the basis of the type alone I am unable to regard it as a distinct species. I have placed it with a query under *S. aquaticus australis*.[2]

A specimen from Orange Hammock, Kissimmee River, De Soto County, Florida, which is a locality nearer to Tampa Bay than any from which specimens have yet been obtained, is like Gainesville specimens, but is a little smaller and is also grayer. The *foramen magnum* is of the usual form. The gray coloration may be due to the fact that the specimen was in alcohol for some three months.

The relation of the Florida form to those of the Gulf States is

[1] Proc. Acad. Nat. Sci. Phila., 1894, p. 157.

[2] I have examined a skull from Biloxi, Miss. (No. 7268, alc., U. S. N. M.), which may compel me to alter this opinion. It has a very small oval *foramen magnum*, and the tail in the alcoholic skin is very short. The skull has the remarkable peculiarity of having no anterior lower incisors.

important, because Dr. J. A. Allen has described as different a form said to be from Presidio County, Texas, but probably Aransas County, under the name of *S. texanus*.[1] Dr. Allen first made this a subspecies of "*argentatus*," but later established it as a distinct species.

The type is, unfortunately, a very much worn and discolored specimen, which, like the type of *S. parvus*, presents the appearance of having been kept in confinement. The description of the color given in the original diagnosis is, therefore, of comparatively little value. A series of winter specimens from Aransas County, belonging to the American Museum, do not differ at all as regards coloration from winter specimens from Florida, except in the occasional increased intensity of the rusty orange suffusion on the forehead, wrists, etc. A June specimen from Texas, however, is paler than late spring specimens from Gainesville, Florida. None of the skins in the Aransas County series show the degree of pallor found in a September specimen near Santa Rosa, Cameron County. One from Padre Island is also much paler, and this and another from the same place show an extremely strong rusty suffusion.

In referring to the Texas form since the publication of the original description, Dr. Allen has not brought forward any additional characters, but lays stress[2] on the rusty suffusion. In this he is entirely justified. No other specimens show this peculiarity as do the Texas ones. On the other hand, however, Florida specimens and others from further north, e. g., from North and South Carolina and Maryland, exhibit it to a greater or less degree. It seems to be a characteristic of adult or old males. The females show it but little and the young not at all.[3]

Langdon remarks on this peculiarity in connection with the subspecies *machrinus* in Ohio:

> Specimens showing orange-colored spots or streaks on the ventral surface and about the mouth are of somewhat frequent occurrence. (Journ. Cincinn. Soc. Nat. Hist., III, 1880, p. 302.)

There is practically no difference in size between *texanus* and *australis*, so far as can be judged from the length of the skull. The average total length of 7 adult skulls from Rockport is 30.9 mm., and of 5 adult skulls from Florida, 31 mm. The Texas skulls differ from the Florida ones, however, in a number of details, and to this I shall refer again presently. From the intermediate region I have only two adult skulls for comparison. One from Grand Cotean, Louisiana, has a total length of 32.5 mm., and one from Biloxi, Mississippi (both localities near the coast), 31 mm.

Taking the seven specimens of *texanus*, in which the skulls have an average total length of 30.9 mm., I find that the hind foot, without the claw (measured on the dry skins), has an average length of 15.4 mm.

[1] Bull. Amer. Mus. Nat. Hist., III, 1891, p. 221.

[2] Bull. Amer. Mus. Nat. Hist., V, 1893, p. 200.

[3] For further remarks on this rusty suffusion see p. 31.

In the only two specimens of *australis* which can be used for comparison (the type and another) the skull is 31 mm. long, and the hind foot has a length of 15 mm. and 15.4 mm. respectively. It would seem probable from this that there is no appreciable difference in the relative length of the hind foot in these two forms. As somewhat confirming this opinion, I find that the average measurements of eight females of *texanus* (measured when fresh) recently given by Dr. Allen agree very closely with average measurements of seven fresh specimens (females also) in the National Museum collection from Raleigh, North Carolina. In the former, the hind foot 12.3 per cent of the total length, and in the latter 12.4 per cent.

In opposition to these apparently close resemblances in proportions, we find that the tail is much longer in *texanus* than in *australis*, being about 18 per cent of the total length in males of the former variety and 13 per cent in the latter. The skull of *texanus*, as already mentioned differs in some respects from that of *australis*. Very striking in the former is the enlargement of the muzzle and the massiveness of the coronoid process of the mandible. This process has generally a straight posterior margin in *texanus*, but a concave one in *australis*. Further, the molar teeth in *texanus* are relatively larger and more nearly square in outline, and the first upper premolar is very small.

On account of the large size of the molars, the mandible is heavier and deeper than in the Florida mole.

These peculiarities of the teeth and skull appear to me to connect the Texas mole with the large Mississippi Valley *machrinus*, and I am disposed to regard the form as connected with typical *aquaticus* through that channel. Whether *texanus* is connected also with *australis* appears to me more uncertain. Specimens from about New Orleans, however, exhibit characters intermediate between *australis* and *texanus*. Thus, in specimens from Louisiana and Mississippi, the molar teeth are moderately large and the upper premolar is neither very large nor very small. Such specimens as are at hand, however, do not show the rusty suffusion in any striking manner; indeed, not as much so as specimens from Florida, the Carolinas, and elsewhere. The material at command is scarcely sufficient for a determination of the questions at issue, and conjectures in this case will be of little value.[1]

[1]After the foregoing paragraphs were in type I had the opportunity, as already stated, of examining Mr. Bangs' interesting collection, which contains five specimens from Mer Rouge, Louisiana, and an excellent series of adults from Oak Grove, Florida. An examination of the skulls of the Florida series makes it more evident that in cranial characters, as in size, *australis* very closely resembles *texanus*, the greater breadth of the muzzle in the latter being perhaps the only difference of any magnitude and constancy.

The Louisiana specimens are rather puzzling, but they have the long tail and broad muzzle of *texanus*. The skulls are larger than typical *texanus*, as might be expected. Two skins exhibit the rusty suffusion on the breast very strongly. Three adults, measured when fresh, give average dimensions as follows: Total length, 157.7 mm.; tail, 30 mm.; hind foot, 20.7 mm.

Northern Louisiana appears to be a region of intergrades of typical *aquaticus* from around the southern extremity of the Alleghanies, *texanus* from the southwest, and *machrinus* from the north.

SEASONAL CHANGES OF PELAGE.

The winter fur in *Scalops* is longer and grayer in color than the summer fur.

The males of this species in the northern part of the range shed the winter fur in May and the summer fur in October. The females commonly undergo the changes during the same months, but the process is frequently retarded in spring from causes connected apparently with reproduction. Thus a female from the Central Park, New York (Amer. Mus. Coll., 1610), obtained July 12, presents the worn winter pelage, with the spring pelage concealed beneath it. Another female (Merr. Coll., 2750) from Laurel, Maryland, obtained June 23, has the long winter fur on the middle of the back, while the rump and shoulders are clothed with the shorter fresh spring fur. In still another specimen, an adult female from Washington City (Dept. Agric. Coll., 22858), obtained July 1, though the long winter fur has been shed from the greater part of the back, it still remains on the anterior portion.

The time of the spring change appears to vary considerably with the latitude, and specimens from the Northern States begin to shed later in spring than those from the South. A nursing female from Oak Lodge, Florida, in Mr. Bangs' collection, obtained February 21, has new fur on the lower surfaces, except a narrow band across the abdomen. There is certainly no retardation in this case. A male from the same locality, taken February 26, apparently has new fur on the shoulders.

Two fall specimens (males) from Padre Island, Texas, taken November 6 and 9, have not completed the molt. Hence it may be supposed that the fall change is somewhat delayed at the South.

The winter fur, as already intimated, is much longer than the summer fur and darker in color.

INDIVIDUAL VARIATIONS IN DENTITION AND COLORATION.

A considerable number of the skulls of *Scalops* which I have examined possess greater or less abnormalities of dentition. These usually consist in the retention or suppression of teeth which are normally absent or present respectively. One of the most striking of these deviations is the presence of an extra lower premolar in front of the usual ones. In two cases of adult skulls which have come under my observation this tooth is present on both sides, and in another instance on one side only. In one of the skulls this extra tooth is large and prominent, but in the others it is filiform. It is perhaps doubtful whether this should be regarded as an abnormality. In all the quite young skulls which I have examined, this tooth is present usually on both sides of the jaw. I have been unable to detect any milk tooth corresponding to this small extra tooth, but as this would in any case be extremely minute it has probably escaped my scrutiny. It may be remarked further in this connection that many jaws in which this tooth can not be detected exhibit at the point where it should occur a small

depression or an irregularity of the structure of the bone which would lead one to suspect that a careful histological study of the region might bring a rudiment of the tooth to light in many instances.

The most common cases of suppression of teeth are those in which one or both of the filiform second and third upper incisors are absent. In many cases the absence of these teeth is probably due to ordinary wear, but in other cases they appear to have been absent from the start. Some eight or nine such cases have come under my observation. A very singular abnormality in a skull from Mississippi (skin No. 7268 N. M.) is the absence of the first lower incisor on both sides. In five cases I have found the first upper premolar lacking either on one side or on both sides.

None of these abnormalities can be correlated with geographical distribution, but occur sporadically in different parts of the country. In no case where I have been able to examine two or more skulls from one locality have I found the same abnormality repeated.[1]

There is a considerable amount of abnormality in coloration in the genus, but it may be said that it always takes the form of complete or partial albinism unless the presence of a rusty suffusion may be

[1] DENTAL VARIATIONS IN SPECIMENS OF SCALOPS AQUATICUS EXAMINED.

A. N. S. P. 3532. Woodville, Alabama.
Lacks first upper premolar on each side and also second upper incisor on each side. (Does not differ otherwise, so far as I can see. Head skin has large white blotch under right arm.)

D. A. 51386.
Lacks I $\frac{2}{2}$ on both sides. Probably fallen out, as teeth are all much worn.

N. M. 4853. Carlisle, Pennsylvania.
Lacks I $\frac{2}{2}$ on both sides and PM $\frac{1}{1}$ on left side. There are depressions, however, and the teeth have *very* probably dropped out. All the teeth much worn.

N. M. 1142. Washington, Mississippi.
I $\frac{3}{3}$ very large. (Skull looks narrow.)

N. M. 955. Carlisle, Pennsylvania.
Has an I $\frac{1}{3}$ on each side. Small, but very distinct.

N. M. 35292. North Carolina.
Lacks PM $\frac{1}{1}$ right side. Evidently deciduous.

N. M. 3922. Georgia?
Right I $\frac{2}{2}$ and I $\frac{3}{3}$ and left I $\frac{2}{2}$ wanting. Those of the right side seem to be merely worn down to the gum. The lower jaw has a trace of an I $\frac{1}{3}$ on each side in the gum.

N. M. 1638. St. Louis, Missouri.
Left I $\frac{2}{2}$ and I $\frac{3}{3}$ and right I $\frac{2}{2}$ wanting. All teeth much worn.

A. M. 4489. Rockport, Texas.
Only a trace of I $\frac{2}{2}$ and I $\frac{3}{3}$ left side and I $\frac{2}{2}$ right side.

A. M. 4485. Rockport, Texas.
Only a trace of I $\frac{2}{2}$ and I $\frac{3}{3}$ both sides.

A. M. 895. Raleigh, North Carolina.
I $\frac{2}{2}$ and I $\frac{3}{3}$ left side and I $\frac{2}{2}$ right, wanting. Evidently deciduous.

A. M. 1002. Raleigh, North Carolina.
Has a small I $\frac{1}{3}$ on left side.

regarded as an abnormality also. I have examined three albino moles of the genus *Scalops*, one each from Georgia, Alabama, and Louisiana.

In the Alabama specimen, which is the only well preserved dry skin, the hair is dull white at the base, then a very delicate tint of orange-tawny and cream-white at the tips. On the head and the lower surfaces the orange tint is considerably stronger.

A large individual from Ohio has the under surfaces and the head and shoulders pure white, but the white area is irregular and occupies more of the right side than the left. A young specimen from Florida has pure white hair on the left side of the breast and around the wrist and a band of the same color extends over the left shoulder. Several specimens which I have examined have white patches of small extent about the mouth, nose, and feet.

CHARACTERISTICS OF YOUNG MOLES.

Though I have never seen fresh specimens of very young moles, I surmise that they must present a very singular appearance. The fur is short and appressed and of a silvery color, and lighter than that of adults. The tail is relatively long, and the claws are long and acutely pointed, especially those of the hind feet. The fore feet are relatively large.

D. A. 30419. Highland, Maryland.
Left I $\frac{2}{2}$ and I $\frac{3}{3}$ wanting.

D. A. 33102. Raleigh, North Carolina.
Left I $\frac{2}{2}$ wanting.

D. A. 30426. Washington City.
Left and right I $\frac{2}{2}$ wanting.

D. A. 57029. Greensboro, Alabama.
Wants right PM $\frac{1}{1}$ and I $\frac{2}{2}$ on both sides.

N. M. 1641. St. Louis, Missouri.
Has I $\frac{3}{3}$ larger than I $\frac{2}{2}$.

N. M. 1642. St. Louis, Missouri.
Evidently same as preceding on right side; on left I $\frac{2}{2}$ is entirely lacking, with no trace.

N. M. 1639. St. Louis, Missouri.
Ditto as regards size of I $\frac{3}{3}$.

N. M. 35202. Illinois?
Left I $\frac{2}{2}$ deciduous.

N. M. 35200. Warsaw, Illinois.
I $\frac{3}{3}$ considerably larger than I $\frac{2}{2}$.

N. M. 35203. Warsaw, Illinois.
I $\frac{2}{2}$ and I $\frac{3}{3}$ both sides gone. A very slight depression the only trace of them.

N. M. 7269. Fairfield County, Ohio.
Has very distinct I $\frac{3}{3}$ on each side. Left PM $\frac{1}{1}$ is absent. (This is a very large specimen with mottled white and gray fur.)

N. M. 1640. St. Louis, Missouri.
I $\frac{2}{2}$ wanting on both sides.

N. M. 1141. Charleston, South Carolina.
Has a small but distinct I $\frac{3}{3}$ on both sides.

D. A. 51386. Rockport, Texas.
I $\frac{2}{2}$ and I $\frac{3}{3}$ on both sides wanting.

HISTORY OF THE SPECIES.

This species occurs in the tenth edition of Linnæus's Systema Naturæ[1] under the name of *Sorex aquaticus*. The diagnosis and description given are quite accurate and there is no doubt as to the species intended. The only synonym, however, is *Talpa, Virginianus, niger*, Seba,[2] which, though cited here and for many years after as an equivalent of *S. aquaticus*, I find to be identical with *Talpa europæa*. As Seba gives an excellent figure of his species, there can be no doubt as to its identity, though why he did not recognize that it was the European mole, is not readily explainable.[3]

As authority in regard to the habitat of his *Sorex aquaticus*, Linnæus cites P. Kalm. Kalm saw the burrows of the mole on the shores of the Schuylkill River at Philadelphia.[4] He remarks on the strength and other characteristics of one captured (probably at some subsequent time), but does not describe it in detail, saying that he intends to do so in another work.[5]

Kerr, in his English edition of Linnæus's Systema Naturæ,[6] published in 1792, introduces an American species, under the name of *Talpa fusca* or the Brown Mole. This is based primarily on the Brown Mole of Pennant, although *Sorex aquaticus*, Linn., and also the *Talpa, Virginianus, niger* of Seba, are quoted as synonyms.[7] Pennant's "Brown Mole" is in turn Linnæus's *Sorex aquaticus*.[8] Pennant's specimens were from New York, whence he obtained his Yellow Mole and also his Radiated[9] and Long-tailed Moles.[9] He mentions especially in this con-

[1] Page 53.

[2] Mus., I, p. 51, pl. 32, fig. 3.

[3] Erxleben seems to have suspected that such was the case. He quotes Seba's name under *Sorex aquaticus*, with a mark of interrogation, and adds "videtus potius varietas Talpae europeae" (Syst. Regn. Anim., 1777, p. 123). Shaw was struck by the resemblance between Seba's species and the European mole, but it did not occur to him to doubt the correctness of the locality given by Seba. He writes as follows: "This species so completely resembles the common European mole in almost every particular, that it might pass for a variety of that animal. * * * It seems to have been first described by Seba, and is, according to that author, a native of Virginia" (Gen. Zoology, I, pt. 1, Mam., 1800, p. 521).

Other moles represented on plate 32 of Seba's work have erroneous localities assigned to them, and one figure (fig. 2) appears to be entirely incorrect. It represents a mole like *Talpa europæa*, with fore feet like a *Chrysochloris*.

[4] Kalm's Travels into North America. Forster's English trans., vol. 1, 1770, p. 90. Forster thinks the species here referred to is *Condylura cristata*, which does not seem to me probable.

[5] This intention was never carried into effect, so far as I know.

[6] Kerr, Animal Kingdom, 1792, p. 202.

[7] Probably Kerr did not propose to establish a new species. He writes: "This and the Crested species, though placed in the Systema Naturæ among the shrews, have the manners and figure of the mole, etc." He probably considered that he had a right to give a new specific name in transferring the species to the genus *Talpa*.

[8] Pennant, Quadrupeds, 3d edition, 1793, p. 232. I have not the first edition.

[9] Equivalent to *Condylura cristata*.

nection that he did not obtain specimens of Seba's *Talpa, Virginianus, niger*, which, of course, was quite natural, as that species is really *Talpa europæa*.

Pennant's "Yellow Mole"[1] became *Talpa europæa flavescens* at the hands of Erxleben,[2] who merely translated the English description into Latin, but adds Seba's *Talpa, Virginianus, niger*, with an interrogation, as a synonym.

Schreber mentions Pennant's "Yellow Mole" under the name of "Der gelbe Maulwurf," but does not give it a Latin designation. He also includes in his summary "Der rothe Maulwurf," which is Seba's "Talpa, rubra, Americana."[3] Under the genus *Sorex* he has "Der Weiss-schwanz. Tab. CLVIII. *Sorex aquaticus* Linn.," citing Seba's "*Talpa, Virginianus, niger*," and Pennant's "Brown Mole," as synonyms.[4]

Gmelin cites Pennant's "Yellow Mole," and gives to the form the name of *Talpa europæa flava*.[5] In 1792 Kerr shortened this name to *Talpa flava*.[6]

Shaw, whose "General Zoology" appeared in 1800, has two American species of moles, besides those referable to *Condylura cristata*. These are the "Purple Mole" and the "Brown Mole." The "Purple Mole, *Talpa purpurascens*," is based on Seba's *Talpa, Virginianus, niger*, and is therefore equivalent to *Talpa europæa* (see p. 40).[7] The "Brown Mole, *Talpa fusca*,"[8] like Kerr's species of the same name, is based on Pennant's "Brown Mole," which, as already stated, is equivalent to Linnæus's *Sorex aquaticus*. Shaw employs this last as a synonym, with a mark of interrogation, and says:

> If this species be the same with the *Sorex aquaticus* of Linnæus, it has, according to that author, webbed fore feet, and, from its name, should seem to inhabit watery places; but neither of these circumstances are mentioned by Mr. Pennant.

In 1820 Desmarest introduced the name *Scalops canadensis* for our species,[9] though for what reason does not appear, unless employed as a translation of Cuvier's "Scalope du Canada."[10] In this he was followed by Godman in 1831.[11]

Harlan's *Scalops pennsylvanica*[12] appears to be the present species. This form was supposed by Harlan to differ from *Scalops aquaticus* in

[1] Quadrupeds, 1771, p. 312 (*fide* Baird); ditto, 3d ed., II, 1793, p. 230. Really given as a variety of the European mole.

[2] Syst. Regn. Anim., 1777, p. 118.

[3] Säugethiere, III, 1778, pp. 559 and 561.

[4] Loc. cit., p. 566.

[5] Gmelin, Linn. Syst. Nat., 13th ed., 1788, p. 110.

[6] Kerr, Anim. Kingdom, 1792, p. 201.

[7] Shaw, Gen. Zool., I, pt. 1, Mam., 1800, p. 521.

[8] Loc. cit., p. 524.

[9] Mammalogie, pt. 1, 1820, p. 155.

[10] Règne Anim., 1st ed., I, 1817, p. 135.

[11] Amer. Nat. Hist., I, 1831, p. 84.

[12] Fauna Americana, 1825, p. 33.

the form of its molar teeth, but, as his description of them agrees with the latter species, it is supposable that he was misled by the descriptions of F. Cuvier and Desmarest. He gives the whole number of teeth as 40, or 4 in excess of the proper number. This was due to the addition of 4 "false molar" teeth to the dental formula, an error which probably crept in unintentionally, as he states in another place that "this species corresponds in the number and arrangement of its teeth with the genus *Scalops* of F. Cuvier." The type (a skeleton) was presumably from Pennsylvania.

The error in the dental formula of Harlan's *Scalops pennsylvanica* led Lesson, in 1827, to establish the genus *Talpasorex* for the reception of the species.[1]

The first reference to the common mole, under the name now used, appears to be that in F. Cuvier's work on the teeth of mammals, published in 1825.[2] This is not quite in the regular form, as he gives merely the name of the genus *Scalops* in his systematic index, and under it "Scalope aquatique, *sorex aquaticus*, Linn."

The intention, however, was clearly to name the species *Scalops aquaticus*, but this was not formally done, so far as I have been able to ascertain, until 1829, when it occurs in Fischer's Synopsis Mammalium.[3]

In 1842 Bachman published an admirable revision of the American moles,[4] in which he cleared up the synonymy of the species under consideration, and corrected many misapprehensions prevailing at that time.

In 1853 Dr. John L. LeConte attempted a revision of the American moles on the basis of specimens in the museum of the Philadelphia Academy.[5]

He considered that the genus *Scalops* was not well founded, and returned all the species to the genus *Talpa*, which he then proceeded to divide into sections. These sections, one, two, and three, cover quite exactly the genera *Talpa*, *Scapanus*, and *Scalops*, respectively, as they were currently adopted. With the first section, of which the type was *Talpa europæa*, we have no concern. The second section contained *Talpa breweri*, *Talpa ænea*, *Talpa townsendii*, and *Talpa taeniata*. *Talpa breweri* is the species recognized in this work as *Parascalops breweri* (Bachman), and the other species are supposed to be identical with *Scapanus townsendi*, as will be more fully stated when considering that genus.

The third section contains, besides *Scalops aquaticus*, a species called *Talpa pennantii*, which, as LeConte states, "appears to be the yellow mole of Pennant."[6] It is not based on this, however, but on a specimen

[1] Lesson, Manuel de Mammalogie, 1827, p. 124.

[2] F. Cuvier, Dents des Mammifères, 1825, p. 251.

[3] Page 219.

[4] Boston Journ. Nat. Hist., IV, 1842, p. 26.

[5] Proc. Acad. Nat. Sci. Phila., VI, 1853, p. 326.

[6] If Pennant's "yellow mole" were a valid species, LeConte's name would, of course, have no standing, as the former received a Latin appellation long before LeConte's paper appeared.

in the Philadelphia Academy Museum, which, from its large size and other characters, would seem to be the same as *Scalops aquaticus argentatus*. The description is far from satisfactory.

LeConte refers in the paper under consideration to the *Talpa cupreata* of Rafinesque, which, he says, is "unknown in recent times." So far as may be judged from Rafinesque's diagnosis, the name should be considered a synonym of typical *Scalops aquaticus*. The tail, however, is short ("le septième de la longueur"), which may possibly indicate that Rafinesque's specimen was from Florida,[1] and represented the subspecies *australis*. This is unlikely, however, as in a reference to it subsequent to the original description he remarks that it was "one of the moles found in the Atlantic States."[2]

DESCRIPTION OF THE TYPE SPECIMEN OF SCALOPS PARVUS, RHOADS.

No. 1468. Male. Tarpon Springs, Florida, December 24, 1893. (Rhoads collection.) Collector's measurements: "L., 4.60; T., 0.60; H. ft.(?), 0.73."

This is probably an adult, but the great wearing of the teeth would appear to be due to its having been kept in confinement. All the sutures are closed and there is a small crest. (The left zygomatic arch and coronoid are broken.)

The skin measures 0.113 mm. from tip of snout to base of tail; tail, without hairs, 16 mm.; hind foot and claw, 16.5 mm.; hind foot, without claw, 14 mm.

General color silvery brown. The wrists, the region of the eyes, and two spots on the breast are rust-colored.

The front claws have upon them a deposit of quartz grains united by a black pasty material.

Dimensions of the type skull.

	mm.
Greatest length	29.5
Basilar length (Hensel)	24.0
Mastoid breadth	15.3
Greatest zygomatic breadth	13.8
Palate length (inside incisors)	12.3
Angle to coronoid of mandible (angle broken)	8.3

[1] Through the kindness of Mr. Howard M. Ballou, of Melrose Highlands, Massachusetts, I am able to quote Rafinesque's diagnosis from the rare work in which it occurs. This is the "Précis des découvertes et travaux somiologiques." Palermo, 1814. The diagnosis, which occurs on p. 14, is as follows: "Talpa cupreata. Queue le septième de la longueur, totale brun luisant argenté, à reflets cuivrés et pourprés, gorge légèrement roussâtre, museau couleur de chair et nu, pieds concolors.—Obs. de l'Amér. septentrionale."

[2] Atlantic Journal, 1832, p. 61.

DESCRIPTION OF THE TYPE SPECIMEN OF SCALOPS AQUATICUS AUSTRALIS, CHAPMAN.

$\frac{3946}{22900}$. Gainesville, Florida, May 4, 1891. F. M. Chapman. (Amer. Mus.)

This is a rather young individual, as shown by the skull, in which the teeth are unworn and the outlines of the nasal bones and even the suture between the premaxillæ and maxillæ are still distinguishable. There is no crest and the occipital and other posterior sutures are open.

The skin measures 99 mm. from tip of snout to base of tail; tail without hairs, 21 mm.; length of fore foot and claws, 19 mm.; width fore foot, 16 mm.; length hind foot and claws, 17 mm.

The general color is silvery brown, which is exactly matched by specimens from farther north, notably No. 22843, D. A., Washington City, which is a little older.

The hairs of the snout, wrists, backs of feet and tail are dull white, without any rusty admixture.

DESCRIPTION OF THE TYPE SPECIMEN OF SCALOPS TEXANUS, J. A. ALLEN.

$\frac{3488}{2740}$. Presidio Co.? Texas. Wm. Lloyd. 1887. (Amer. Mus.)

The skin is in poor condition. The animal appears to have been kept in confinement, as the claws are long and irregular.

The color is dull brown, with an irregular soiled rusty area on the under side of the body, from the jaw to the middle of the belly, and other spots of the same on the belly and sides. There is more of this rusty color about the sides of the head and around the wrists.

The color is similar to that of the Rockport, Texas, series, but is browner, due apparently to the fur being worn and faded. The skin does not show bright orange red spots about the eyes which are present in many of the Rockport specimens, but there is a dull reddish brown in the same situation.

The skin measures as follows:

	mm.
Head and body	100.0
Tail vertebræ	21.0
Fore foot and claw	19.5
Hind foot and claw	17.0

The skull, which is much broken, measures as follows:

	mm.
Length of upper tooth row	14.8
Breadth across palate, between post-external angles of first molars	10.0

Average dimensions of 10 fresh specimens, S. a. typicus (Bangs Coll.).

Locality.	Total Length.	Length of tail.	Length of hind foot.	Breadth of fore foot.
Wareham, Mass. (5)	159.3	26.6	19.5	20.5
Liberty Hill, Conn. (5)	169.0	—29.0	20.0	.....

Dimensions of skulls of Scalops aquaticus typicus.

Catalogue number.		Collection.	Locality.	Sex.	Total length.	Basilar length (Hensel).	Length of palate from inside first incisor.	Mastoid breadth.	Greatest zygomatic breadth.	Breadth between postero-external angles of first molars.	Height of coronoid process.	Age.
Skull.	Skin.				*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	
3546	.....	Bangs	Wareham, Mass	♂	34.6	28.2	15.4	18.2	15.8	10.0	4.8	Adult.
706	.....	do	do	♂	34.0	27.6	14.8	17.6	15.6	9.9	4.4	Do.
708	.....	do	do	♀	35.0	28.2	15.0	18.0	15.8	10.0	4.7	Do.
3544	.....	do	do	♀	32.5	26.4	14.0	17.5	15.0	9.6	4.0	Do.
705	.....	do	do	♀	32.5	26.0	14.0	17.5	15.0	9.5	4.0	Do.
704	.....	do	Liberty Hill, Conn.	♂	36.0	29.5	15.8	18.6	.....	10.5	4.8	Do.
4276	.....	do	do	♂	35.8	29.2	15.8	18.4	16.0	9.6	4.2	Do.
701	.....	do	do	♀	35.0	28.9	15.5	18.2	16.0	9.6	4.6	Do.
702	.....	do	do	♀	35.2	29.6	15.0	18.5	16.0	10.4	4.8	Do.
703	.....	do	do	♀	35.0	28.9	15.2	18.4	16.0	10.3	5.0	Do.
2478	3184	Amer. Mus.	Tarrytown Heights, N. Y.		.....	.....	15.8	.....	.....	10.9	.....	Youngish.
2479	3185	do	Tarrytown Heights, N. Y.		.....	.....	16.2	.....	.....	.....	4.0	
1537	2539	do	Dunwoodie, N. Y.		33.5	28.0	14.7	17.5	15.3	9.7	3.3	Adult, or less.
1207	.....	Merriam	Sing Sing, N. Y.		33.4	27.7	15.0	17.2	15.0	9.2	4.0	Adult.
1206	.....	do	do	♂	36.0	29.6	15.8	18.3	15.8	10.1	3.9	Do.
1790	1129	do	do		34.5	28.5	15.0	17.6	15.0	.....	4.5	Do.
793	1594	Amer. Mus.	Hastings, N. Y.	♀	.....	.....	15.4	18.5	.....	9.4	.....	
809	1610	do	Central Park, N. Y.	♀	36.0	29.8	16.0	17.9	.....	10.0	4.4	Adult, or less.
2274	2850	do	Englewood, N. J.		36.8	30.0	16.1	19.0	16.0	9.8	4.5	Adult, or less.
583	.....	Nat. Mus.	Carlisle, Pa		35.4	29.0	15.7	17.7	15.8	9.4	4.0	Youngish.
4852	.....	do	do		35.0	29.0	15.0	17.7	15.5	9.7	4.0	Do.
4853	.....	do	do		34.8	28.6	15.0	18.2	16.0	9.7	3.7	
4851	.....	do	do		34.4	28.9	15.0	18.0	15.5	9.9	4.0	
35060	.....	do	Baltimore, Md		33.8	28.0	14.5	17.5	15.5	9.8	.....	
30419	.....	Dept. Agric.	Highland, Md	♂	35.4	29.8	15.5	.....	.....	9.8	3.8	
3389	.....	Merriam	Laurel, Md	♂	34.2	28.6	15.0	17.8	.....	9.6	3.4	Young.
3387	2750	do	do	♀	33.6	28.2	15.0	17.2	15.1	9.3	3.3	Youngish.
3388	2751	do	do	♀	32.3	26.6	14.0	16.5	.....	9.0	3.5	Do.
35072	19370	Nat. Mus.	Baltimore, Md	♀	32.4	27.4	14.4	17.3	15.0	9.4	4.0	Adult.
30296	22843	Dept. Agric.	Washington, D. C.	♀	34.8	29.0	15.1	17.6	15.0	9.6	3.4	
30303	22850	do	do	♀	.....	.....	14.6	17.5	15.0	9.4	3.2	
30297	22844	do	do	♂	34.4	29.0	15.2	17.8	15.6	9.7	3.4	
30311	22858	do	do	♀	33.5	28.2	14.8	17.6	14.9	9.2	3.4	Do.
30426	.....	do	do	♂	32.6	27.0	14.3	16.7	14.6	9.0	3.2	
59607	.....	Nat. Mus.	Brightwood, D. C.	♂	33.0	27.5	14.3	17.9	15.6	9.4	4.0	Do.
1935	754	do	District of Columbia		33.8	27.8	14.6	16.8	14.6	9.2	.....	
23114	16317	do	Ballston, Va		.....	.....	14.6	.....	.....	9.6	3.8	
1140	158	do	Clarke County, Va.		34.4	28.8	15.3	17.8	15.4	9.0	3.9	
668	1444	Amer. Mus.	Raleigh, N. C.	♀	33.0	27.0	14.3	17.0	14.5	9.3	3.1	Youngish.
2796	.....	Merriam	do	♂	33.0	27.4	13.8	17.2	14.7	8.7	3.9	Adult.
936	1258	Amer. Mus.	do		32.8	27.6	14.3	17.0	15.0	9.0	3.6	Do.
895	1717	do	do		32.2	26.0	14.0	.....	14.3	8.6	.....	Do.
33173	25767	Dept. Agric.	do	♀	32.0	26.0	13.6	16.7	14.2	8.8	3.6	Do.
33175	25769	do	do	♀	31.8	25.9	13.6	16.3	14.3	8.5	3.3	
33174	25768	do	do	♀	31.6	25.9	13.2	16.6	14.2	8.6	4.2	
894	1716	Amer. Mus.	do	♂	31.5	25.7	13.2	16.4	14.0	8.8	3.4	Do.
33172	25766	Dept. Agric.	do	♀	31.2	25.8	13.2	16.5	14.2	8.6	.....	
669	1445	Amer. Mus.	do	♀	31.0	26.0	13.3	15.8	13.8	8.4	4.0	Youngish.
1002	1137	do	do	♀	31.0	25.7	14.1	16.3	14.3	8.8	3.8	Adult, or less.
2361	3048	do	Asheville, N. C.		32.0	27.0	14.0	17.3	15.0	9.6	3.7	
2801	2291	Merriam	Highlands, N. C.	♀	33.0	27.6	14.5	17.7	.....	9.5	4.2	Adult.
54748	.....	Dept. Agric.	Roan Mountain	♂	36.0	30.1	16.0	18.6	16.6	.....	4.4	Do.
35292	19854	Nat. Mus.	(3,500 ft.), N. C. Raleigh, (?) N. C.		31.4	25.8	13.3	16.6	.....	8.6	3.9	Do.
508	1079	Amer. Mus.	Frogmore, S. C.	♂	.....	.....	13.7	16.6	14.5	8.6	4.0	Young.
35272	19792	Nat. Mus.	do	♂	33.2	27.0	14.6	17.5	.....	9.5	3.7	Adult.
1505	.....	Merriam	do		33.8	28.0	14.6	17.4	15.8	9.3	3.7	Adult, or less.
1440	.....	do	do	♂	33.6	27.2	14.2	17.4	15.5	9.1	.....	Adult, or less.
1525	923	do	do		32.5	27.0	14.2	17.0	15.0	9.4	3.5	Adult.
1141	.....	Nat. Mus.	Charleston, S. C.		32.2	26.4	13.4	16.8	.....	9.0	3.9	

Dimensions of skulls of Scalops aquaticus australis.

Catalogue number.		Collection.	Locality.	Sex.	Total length.	Basilar length (Glenoid).	Length of palate from inside first incisor.	Mastoid breadth.	Greatest zygomatic breadth.	Breadth between postero-external angles of first molars.	Height of coronoid process.	Age.
Skull.	Skin.				*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	
1130	1858	Amer. Mus.	Gainesville, Fla	♀	31.0	25.2	13.2	16.4	14.2	9.6	3.7	Adult.
3461	.....	Bangs	Oak Lodge, Fla	♂	30.5	26.0	13.0	16.4	14.5	8.8	4.0	Do.
3462	.....	....do	....do	♂	31.0	26.0	13.2	16.0	14.4	8.8	4.0	Do.
3463	.....	....do	....do	♂	30.0	25.0	13.3	15.8	13.8	8.2	3.8	Do.
3464	.....	....do	....do	♂	31.0	25.5	13.0	16.6	.....	9.0	4.0	Do.
3465	.....	....do	....do	♂	31.0	25.8	13.0	16.0	.....	9.0	4.0	Do.
3466	.....	....do	....do	♂	30.5	24.5	13.0	16.4	14.5	9.0	4.0	Do.
3469	.....	....do	....do	♂	31.0	25.0	13.2	16.0	14.2	8.2	4.0	Do.
3470	.....	....do	....do	♂	30.5	24.8	12.8	16.0	14.0	9.0	4.0	Do.
3471	.....	....do	....do	♂	30.6	26.0	13.2	16.5	14.5	8.5	4.0	Do.
3467	.....	....do	....do	♀	30.0	25.0	13.0	15.5	13.5	8.2	3.8	Do.
3468	.....	....do	....do	♀	30.2	25.5	13.0	16.2	14.4	9.0	4.0	Do.
23510	16579	Dept. Agric.	Hypoluxo and Lake Worth, Fla.	...	27.8	23.2	11.3	.....	.....	7.8	3.2	Do.
63359	.....	Nat. Mus	Orange Hammock, De Soto County, Fla.	♂	30.0	24.2	12.4	16.0	14.0	9.0	3.3	Adolescent.
	7268	....do	Biloxi, Miss	...	31.0	25.6	13.4	16.3	14.1	8.6	3.7	Do.
36935	4841	....do	New Orleans, La	...	32.7	27.2	14.4	16.2	14.2	8.3	3.8	Youngish.

Dimensions of skulls of Scalops aquaticus machrinus.

					mm.	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	
7269	.....	Nat. Mus	Fairfield County, Ohio.	...	.....	.....	17.2	.....	.....	11.2	4.3	
35666	13843	....do	Madisonville, Ohio	...	38.0	31.2	16.6	19.8	17.2	11.0	.....	Old.
4264	3654	Merriam	Eubanks, Ky	...	36.0	30.3	16.1	18.6	16.1	10.8	3.8	Youngish.
46196	34411	Dept. Agric.	Big Sandy, Tenn	♂	38.6	32.3	17.0	20.6	17.7	10.8	4.0	Adult, or less.
36515	21813	Nat. Mus	Hamilton, Ill	♂	39.0	32.8	17.6	20.3	18.4	11.4	4.8	Adult.
2616	1029	....do	Alton, Ill	...	.....	31.0	16.4	18.9	.....	10.5	4.2	Do.
15398	.....	....do	Belleville, Ill	...	36.0	29.2	15.6	19.0	.....	10.4	3.6	
35211	19626	....do	Warsaw, Ill	♀	37.5	31.5	.....	19.6	17.2	.....	4.4	Youngish.
35200	.....	....do	....do	...	.....	.....	17.5	.....	.....	.....	4.5	Do.
35201	19616	....do	....do	♀	36.5	30.5	16.5	18.7	16.7	10.4	4.5	Adult, or less.
35203	19618	....do	....do	♂	35.2	29.0	15.5	19.0	16.4	.....	4.2	Do.
36555	21871	....do	....do	♂	39.8	33.4	.....	20.8	.....	10.5	4.0	Adult.
25350	18580	Dept. Agric.	Elk River, Minn	...	36.2	30.0	15.8	19.3	16.9	10.6	4.4	Do.
53792	.....	....do	....do	♀	34.3	.....	.....	.....	.....	.....	.....	
1831	.....	Amer. Mus	Fort Snelling, Minn	♀	36.3	29.5	.....	18.7	17.0	10.5	4.2	Immature.
43761	31900	Dept. Agric.	Council Bluffs, Iowa	♂	36.4	30.0	15.7	18.8	16.7	10.5	4.0	Adult.
54097	.....	....do	Omaga, Kans	...	37.7	32.6	17.0	19.8	17.7	11.0	4.0	Do.
40407	.....	....do	....do	...	36.3	.....	15.8	19.5	17.0	11.2	4.5	Do.
64225	.....	....do	Bismarck, Mo	♀	36.4	30.3	15.5	19.8	16.5	10.5	4.0	Do.
1638	503	Nat. Mus	St. Louis, Mo	...	38.5	32.0	17.5	20.8	18.2	.....	4.1	Old.
1639	504	....do	....do	...	37.5	31.5	17.0	19.8	17.2	.....	4.5	Adult.
1641	506	....do	....do	...	.....	.....	15.6	18.7	16.8	9.8	4.0	Do.
1642	507	....do	....do	...	35.6	.....	15.5	18.6	16.5	10.0	4.4	Do.
36936	7246	....do	Grand Coteau, La	...	34.0	28.5	14.5	18.0	16.0	9.7	4.0	Do.
2955	.....	Bangs	Mer Rouge, La	♂	34.4	28.2	14.3	17.2	15.5	9.4	4.2	Do.
2956	.....	....do	....do	♂	35.0	29.0	15.0	18.0	16.0	9.5	4.0	Youngish.
2957	.....	....do	....do	♂	34.0	28.0	15.0	17.0	.....	9.2	4.0	Adult, or less.
2958	.....	....do	....do	♂	33.0	27.0	14.0	17.5	15.5	9.1	4.2	Adult.
46384	34293	Dept. Agric.	....do	♀	32.0	26.6	13.7	17.0	15.4	9.4	3.0	Do.
57030	.....	....do	Greensboro, Ala	♂	33.0	27.4	14.2	17.6	15.0	9.2	3.3	Youngish.
57031	.....	....do	....do	♀	32.4	27.2	14.0	.....	15.0	9.4	3.9	Do.
57029	.....	....do	....do	...	31.9	26.8	13.4	17.0	.....	9.0	3.9	Do.

Dimensions of skulls of Scalops aquaticus texanus.

Catalogue number.		Collection.	Locality.	Sex.	Total length.	Basilar length (Hensel).	Length of palate from inside first incisor.	Mastoid breadth.	Greatest zygomatic breadth.	Breadth between postero-external angles of first molars.	Height of coronoid process.	Age.
Skull.	Skin.				*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	
43268	31403	Dept. Agric.	Padre Island, Tex.	♂	32.0	26.8	14.0	17.4	15.1	9.7	3.7	Adult.
43269	31404	.....do.....	.....do.....	♂	31.4	26.4	13.7	17.6	15.3	10.0	4.0	Adult, or less.
42883	31008	.....do.....	Near Santa Rosa, Cameron County, Tex.	♂	30.3	25.3	.....	16.6	.....	.....	.....	Adult.
43267	31402	.....do.....	Corpus Christi, Tex.	♂	32.5	26.5	14.1	17.5	15.3	10.0	4.3	Do.
43534	31664	.....do.....	.....do.....	♂	33.1	27.0	.....	17.5	.....	.....	.....	Do.
4485	5766	Amer. Mus.	Rockport, Tex.	♂	32.4	27.1	14.4	17.5	15.3	9.4	4.0	Do.
4487	5768	... do	.....do.....	♂	32 0	26.0	13.9	17.4	15.2	9.3	4.3	Do.
51498	.....	Dept. Agric.	.....do.....	♂	31.6	26.0	14.3	16.8	.....	8.7	4.0	Do.
51386	.....	.....do.....	.....do.....	♂	31.3	25.6	13.6	16.7	15.0	9.3	4.0	Do.
51385	.....	.....do.....	.....do.....	♂	31.2	25.4	13.8	17.6	15.5	9.7	4.3	Do.
51387	.....	....do.....	.....do.....	♀	30.7	24.9	13 6	16.2	14.7	8.7	.....	Do.
4489	5770	Amer. Mus.	.....do.....	♀	30.6	25.0	13.7	16.6	14.9	8.5	3.9	Do.
4486	5767	.....do.....	.....do.....	♂	30.2	.....	.....	16.4	14.1	8.4	3.7	Do.
4490	5771	.....do.....	.....do.....	♂	30.0	24.7	13.0	16.4	15.0	9.0	4.2	Do.
4488	5769	.....do.....	... do	♀	29.5	24.2	12.8	16.0	.....	8.7	3.7	Do.
51388	.....	Dept. Agric.	San Antonio, Tex.	...	30.5	.....	.....	.....	.....	.....	3.8	Do.
5043	4323	Merriam....	Mason, Tex.	...	31.1	25.6	13.2	16.5	.....	9.2	3.4	Adult, or less.
5044	4324	.....do.....	.....do.....	...	33.3	27.6	14.4	17.8	15.4	9.8	3.4	
5042	4322	.....do.....	.....do.....	...	.....	27.0	14.1	17.5	15.9	9.8	3.3	"Immature."
30913	23494	Dept. Agric.	Fort Reno, Okla.	♂	33.3	27.4	14.2	17.2	15.5	9.3	3.8	Young.
2740	3488	Amer. Mus.	Aransas County, Tex. (?)	...	.....	.....	*14.8	.....	.....	10.0	.....	Type, old.

*Tooth row.

Genus SCAPANUS, Pomel.

Scapanus, POMEL, Archiv. Sci. Phys. and Nat., IX, 1848, p. 247. (Based on *Scalops townsendi* and *S. breweri*, Bachman.)

Body fusiform, depressed. Feet fossorial. Manus very broad, with large *os falciforme*; palms turned outward; toes not webbed. Muzzle produced; nostrils superior. Tail short, thick, terete, scaly, sparsely clothed with long hair. Auricular orifice and eyes minute.

Skull depressed; tympanic bullæ complete; anterior nares somewhat inclined upward. Palate only slightly prolonged behind the last molar. First upper incisors large. Internal basal cusp of molars narrow and simple.

Pelvis with two osseous bridges connecting the sacral vertebræ with the ischium.

Dental formula: i, $\frac{3}{3}$; c, $\frac{1}{1}$; pm, $\frac{4}{4}$; m, $\frac{3}{3}$; total, 44.

This genus is very closely allied to *Scalops*, from which it differs chiefly in the number and relative size of the teeth. In *Scalops* the third lower incisor and the lower canine are wanting in the functional dentition and the premolars are but three above and below, while in *Scapanus* the incisor and canine are present and also four premolars.

The second and third upper incisors in *Scapanus*, though small, are not minute as in *Scalops*.

The nostrils are commonly stated to be "supero-lateral" in *Scapanus* and superior in *Scalops*, but I am unable to discern any difference in their position in the two genera; they are superior in both.

Since establishing the genus *Scapanus*, by Pomel, in 1848, both Townsend's mole and Brewer's mole have been constantly included in it. The latter species presents very distinct osteological characters, however, and I have separated it under the name of *Parascalops*.

Pomel introduces the genus *Scapanus* in the following manner:[1]

"2. type [des Talpiens]. LEPTORHINIENS, trompe grêle aiguë, narines ouvertes près de l'extrémité."

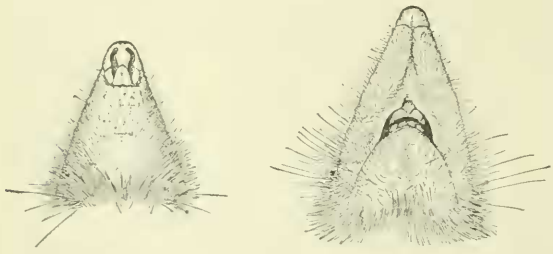
Genres *Hyporyssus*?,[2] *Scalops*, *Scapanus*.

NOTA.—Ce troisième genre diffère des scalops par la position latérale et non supérieure de l'ouverture des narines, et par la formule dentaire comprenant une intermédiaire supérieure et trois inférieures de plus. Les espèces sont: *Scapanus Townsendii* [sic] et *Breweri* (*Scal. Townsendii* [sic] et *Breweri* Bachm.).

EXTERNAL CHARACTERS OF THE GENUS.

Body fusiform, depressed. Head conical. Snout, nostrils, and lips as in *Scalops aquaticus*. Eye minute, concealed in the fur but not covered by membrane. Auricular orifice concealed by the fur, circular, about 1.5 mm. in diameter.

Fore feet very large, as in *Scalops*. Palms (with toes) shorter than soles, subcircular, or about as long as broad; naked and pseudo-tubercular below; sparsely hairy above, with a conspicuous fringe. Toes scarcely webbed. Claws very large and broad, as in *Scalops aquaticus*.



12. 13.

SNOUT OF SCAPANUS TOWNSENDI.

Fig. 12, Upper surface. Fig. 13, Lower surface.

($1^1/_2$ times natural size.

Hind feet long and narrow. Upper surface covered with rather sparse long hairs, the outer of which form a fringe around the sides of the soles, which fringe is especially long on the outer side of the heel. Under surface naked, with one prominent tubercle near the middle. Toes scarcely webbed. Claws very long, compressed, curved, acute.

Tail thick, terete, tapering toward the extremity, and usually con-

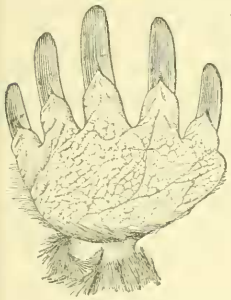
[1] Archiv. Sci. Phys. & Nat., IX, 1848, p. 247.

[2] The mark of interrogation is Pomel's. *Hyporyssus* is a fossil genus from the Tertiary of Auvergne, France.

stricted at the base; skin scaly, clothed with long, coarse hairs, which are not sufficiently numerous to conceal the skin itself.

Fur as in *Scalops aquaticus*.

Color blackish, varying to rich, dark metallic brown and to silvery gray. Under surfaces usually considerably lighter than the back. Hairs plumbeous, with a subterminal whitish, grayish, or rusty ill-defined ring and shining brown, gray or blackish tips. Hairs of the snout white; those of the feet and tail similar, varying to brownish (especially in immature individuals).



14.

15.

FORE FOOT OF SCAPANUS TOWNSENDI.
Fig. 14, Lower surface. Fig. 15, Upper surface.
(Slightly above natural size.)

SKULL.

The skull of *Scapanus townsendi* resembles that of *Scalops aquaticus* so closely in most of its features that I do not think it necessary to describe it in detail, but will point out the characters in which the two skulls differ most conspicuously.

In *Scapanus townsendi* the interparietal[1] is large, broad, and strap-shaped, cutting off the parietals transversely behind, and causing their postero-lateral border to be much shorter than their posterior border. The supero anterior extremity of the premaxillæ is little produced, and hence the anterior nares have the appearance of being directed somewhat upward.

18.

TAIL OF SCAPANUS TOWNSENDI.
(Slightly above natural size.)

16.

17.

HIND FOOT OF SCAPANUS TOWNSENDI.
Fig. 16, Lower surface. Fig. 17, Upper surface.
(Slightly above natural size.)

The palate is short, its prolongation posteriorly beyond the last molar being much less than the diameter of that tooth. It is emarginate behind and notched. The zygomatic arches are short and nearly parallel. They spring anteriorly from a point about opposite the middle of the last molar, and are inserted behind considerably within the margin of the postero-external wing of the squamosal, which latter is

[1] Following De Blainville and Wagner, I regard the portion of the occipital bone anterior to the rudimentary lambdoidal ridge as representing an interparietal. In none of the skulls of American moles which I have examined, however, even the youngest ones, have I found more than an indication of a separation of the interparietal from the occipital. (See De Blainville, Osteographie, 1, Insectivores, p. 4; Wagner, Schreber's Säugethiere, II, p. 106.)

bent backward rather than outward. The termination of the triangular coronoid process of the mandible is broadly truncated. The angular process is large and strongly uncinate.

TEETH.

Dental formula: i, $\frac{3}{3}$; c, $\frac{1}{1}$; pm, $\frac{4}{4}$; m, $\frac{3}{3}$; total, 44.

The first upper incisor is large and elongate, with a convex anterior and flat posterior face and broad cutting edges. The second and third incisors and the canine are subequal, terete, unicuspidate teeth. The first premolar is similar, but decidedly smaller. The second and third premolars are similar; both teeth (especially the third) show a tendency to develop a posterior cusp.

The fourth premolar is larger than any tooth that precedes it. The crown is compressed and recurved and has a large lamellar posterior cusp, and a minute internal basal cusp and also usually a rudimentary anterior basal cusp. The molars are similar to those of *Scalops aquaticus*, the internal basal cusp being compressed and simple and not extending across the posterior external cusp.

The first lower incisor is shorter than the second (and in *Scapanus californicus* much smaller). The third incisor is smaller than the second (in *Scapanus californicus* much smaller). The canine and first, second, and third premolars are subequal and larger. All these teeth are single-rooted and unicuspidate, except the premolars, which tend to form a posterior basal cusp of considerable size. The fourth premolar is larger than the others, with a pronounced posterior basal cusp and a rudimentary anterior one. The molars resemble those of *Scalops aquaticus*.

SKELETON.

The vertebral formula in this genus is as follows: c, 7; d, 14; l, 5; s, 6; ca, 13 (or 14). Total, 45 (or 46). There are seven intervertebral ossicles, of which the anterior one (which is smaller than the rest) is between the penultimate and last dorsal vertebræ, and the last between the posterior lumbar and first sacral.

The sternum consists of 5 segments and a very large manubrium, which is as long as the combined segments. The first pair of ribs joins the sternum a little behind the junction of its intermediate and posterior third. The manubrium is dilated above and moderately grooved, with raised, but only slightly incurved, borders; the keel is not as deep as in *Scalops*, its greatest depth being less than one-third its length.

The clavicles are about two-thirds as long as broad, deeply notched on the inferior border, and not pierced by a foramen.

The scapula is as in *Scalops*, but has a prominent tubercle at the distal extremity of the inferior spine. The humerus is a fourth longer than broad.

The pelvis is extremely narrow, but the bones of the two sides do

not meet below the acetabula. The space between the sacral vertebræ and pelvis is closed in above by osseous bridges leaving only two pairs of foramina of moderate size.

The femur is a fifth shorter than the tibia. The fibula joins the latter a little above the middle.

The *os falciforme* is large and strap-shaped, only slightly curved and with an oblique proximal articulate surface. Terminal phalanges bifid.

KEY TO SPECIES OF SCAPANUS.

A. Premolars $\frac{4}{4}$.
  a. Color blackish. Face long; suborbital bridge broad—
    aa. Size very large (total length, 184 mm. alc.)..... *townsendi* (p. 51.)
    bb. Size very small (total length, 158 mm.)..... *orarius* (p. 52.)
  b. Color brown or brownish silvery. Face short; unicuspidate teeth crowded. Suborbital bridge slender. Size moderate..... *californicus* (p. 52.)
B. Premolars $\frac{3}{4}$. Color dusky brown. Size very small (total length, 135 mm.). *anthonyi* (p. 53.)

SCAPANUS TOWNSENDI (Bachman).

TOWNSEND'S MOLE; OR OREGON MOLE.

Scalops canadensis, Richardson, Fauna Bor. Amer., pt. 1, 1829, p. 9. [Not of Desmarest or Harlan.]

Scalops Townsendii, Bachman, Journ. Acad. Nat. Sci. Phila., VIII, pt. 1, 1839, p. 58; Proc. Boston Soc. Nat. Hist., I, 1841, p. 11; Boston Journ. Nat. Hist., IV, No. 1, 1842, p. 31; Journ. Acad. Nat. Sci. Phila., VIII, pt. 2, 1842, p. 291.

Scalops latimanus, Bachman, Boston Journ. Nat. Hist., IV, No. 1, 1842, p. 31.

Scapanus Tow[n]sendii, Pomel, Archiv Sci. Phys. & Nat., IX, 1848, p. 247.

Scalops metallescens, Cassin, Proc. Acad. Nat. Sci. Phila., VI, 1853, p. 242. (*Nomen nudum.*)

Scalops aeneus, Cassin, Proc. Acad. Nat. Sci. Phila., VI, 1853, p. 299.

Talpa taeniata, LeConte, Proc. Acad. Nat. Sci. Phila., VI, 1853, p. 327.

Size very large. Color blackish. Tail twice as long as the fore foot (without the claws); the latter shorter than the hind foot. Face long (interval between first upper incisor and last premolar equal to length of the three upper molars).

Upper unicuspid teeth separated by equal intervals. First lower incisor approaching the second in height.

Suborbital bridge broad and pressed close to the side of the skull. Coronoid process of mandible broadly truncated.

Dimensions (No. 2212. Fort Steilacoom, Washington. Female. Alc.)—Total length, 184 mm.; head and body, 141 mm.; head, 52.5 mm.; tail vertebræ, 39.5 mm.; length of hind foot (without claw), 20.5 mm.; length of fore foot (without claw), 19 mm.

Average dimensions of skulls.—Total length, 41.4 mm.; mastoid breadth, 19.9 mm.; length of palate from outside of incisor, 18.6 mm.

Distribution.—Washington and Oregon, between the Cascade Mountains and coast range, extending in the extreme northwestern portion of California to Crescent City.

SCAPANUS ORARIUS, new species.

COAST MOLE.

Similar to *S. townsendi*, but representing nearly the opposite extreme as regards size. Head and body not exceeding 128 mm.; color, dark.

Skull and teeth as in *S. townsendi*, and the face long.

Dimensions (No. 3480, G. S. Miller. Sumas, British Columbia).—Total length, 158 mm.; tail, 30 mm.; hind foot, 20 mm.

Dimensions of skull.—Total length, 32.8 mm.; mastoid breadth, 16 mm.; length of palate from outside of incisor, 14.3 mm.

Geographical distribution.—Seacoast of Washington and Oregon, from the Coquille River northward, and along the shores of Puget Sound to Simiahmoo and to Chiloweyuck Depot and Sumas, British Columbia. Fort Walla Walla, Washington.

Type.—No. 381, U.S.N.M. Female. Shoalwater Bay, Washington. August 30, 1855. Dr. J. G. Cooper.

SCAPANUS CALIFORNICUS (Ayres).

CALIFORNIA MOLE.

Scalops californicus, AYRES, Proc. Calif. Acad. Nat. Sci., I, 1855, p. 54.
Scapanus dilatus, TRUE, Proc. U. S. Nat. Mus., XVII, 1894, No. 999, p. 242.

Size moderate (with a considerable geographical variation), not reaching that of *S. townsendi*. Color gray-brown, often pale or more or less suffused with rust color. Face short (the interval between the first upper incisor and last premolar equal only to the first and second upper molars).

Unicuspidate teeth crowded and more unequal in size than in *S. townsendi*. First lower incisor very short; second, long and canine-like.

Skull delicate; suborbital bridge slender, not pressed in toward the sides of the skull.

Average dimensions (4 fresh specimens from Nicasio, Marin County, California).—Total length, 179 mm.; tail vertebræ, 35 mm.

(No. 12624, U.S.N.M., alc.; Santa Barbara, California, male, adult: Total length, 154 mm.; head and body, 121 mm.; head, 45.5 mm.; tail vertebræ, 33.5 mm.; hind foot (without claw), 17 mm.)

Average dimensions of skulls (7 adults from Nicasio, California).—Total length, 36.3 mm.; length of interval between first upper incisor and last premolar, 5.5 mm.; greatest mastoid breadth, 17.4 mm.; greatest zygomatic breadth, 14.4 mm.

(Average dimensions of skulls from Alhambra, San Bernardino, and San Gabriel, southern California: Total length, 32.3 mm.; greatest mastoid breadth, 15.9 mm.)

Geographical distribution.—All California west of the coast range (except the extreme northwestern portion), and the Sierra Nevadas at varying altitudes, and east thereof at Owens Lake, Lake City (Modoc County), and Lake Tahoe, California, and Fort Klamath, Oregon.

Type locality.—San Francisco, California.

SCAPANUS ANTHONYI, J. A. Allen.

ANTHONY'S MOLE.

Scapanus anthonyi J. A. ALLEN, Bull. Amer. Mus. Nat. Hist., V, 1893, p. 200.

Smaller than the average of specimens of *S. californicus* from southern California, and the color considerably darker. Length, 135 mm.; tail, 26 mm.

"*Cranial characters.*—Similar in general to those of *S. townsendii*, except that the interorbital and rostral portions of the skull are relatively broader. The fourth premolar on one side, however, is wanting, and on the other is rudimentary; but this may be abnormal.[1] Extreme length, 30 mm.; basilar length, 28.5 mm.; least interorbital breadth, 7.6 mm.; greatest mastoid breadth, 15.3 mm.; lower jaw, incisive border to condyle, 22.4 mm.

"*Type.*—No. $\frac{63}{19}\frac{13}{17}$, ♂ ad., San Pedro Martir Mountains (alt. 7,000 feet), May 8, 1893. Coll. A. W. Anthony.

"This species is based on a single male specimen, and, although so small, the worn condition of the teeth show it to be an old individual.

"In general bulk *S. anthonyi* is less than half the size of *S. townsendii* [read *S. californicus*] from Nicasio, California." (Allen.)

GEOGRAPHICAL DISTRIBUTION.

The distribution of the moles of the genus *Scapanus* on the Pacific Coast, so far as it may now be known, presents many interesting peculiarities. The range of the genus extends from Chiloweyuck Depot in British Columbia just north of the United States boundary to the San Pedro Martir Mountains, Lower California. In four instances specimens have been taken from east of the Cascades and Sierra Nevada Mountains, namely, at Fort Walla Walla, Washington; Fort Klamath, Oregon; Bijou, on Lake Tahoe, California, and Olancha, on Owens Lake, California.[2] Otherwise, all the specimens examined as well as those mentioned in the literature are from localities west of the summits of the Cascades and Sierra Nevadas, and south of the latter mountains. The moles are abundant about Puget Sound and in the western valleys of Washington and Oregon, as shown by both specimens and records.[3]

They have also established themselves east of the mountains at Fort Walla Walla, where three were obtained by Major C. E. Bendire. Farther south they have passed through the mountains to the region of

[1] I find only three premolars on either side.

[2] I have recently noticed a specimen in the collection of the Department of Agriculture from Lake City, Modoc County, California, June 15, 1895. It is of a silvery color and resembles the Shasta County specimens. The fur is long and silky, but dull. The skull, which is not adult, is of the following dimensions: Total length, 35 mm.; interval between first incisor and last premolar, 5.8 mm.; mastoid breadth, 15.6 mm.

[3] "Well known to the farmers and settlers in the valleys of Oregon." (Aud. & Bach., Quadrupeds, III, p. 219.)

the Klamath Lakes. Major Bendire obtained three specimens at Fort Klamath. Feilner found moles in this region in 1864. He writes:

> I have two kinds, one caught on Bogus Creek, with glistening silver-gray fur, and the other on Klamath River, with black fur and velvet-like appearance.[1]

At the junction of the Sierra Nevadas with the coast range at the northern boundary of California the area of distribution appears to divide, one arm following the coast range and covering the country toward the ocean, and the other extending southward in the Sierra Nevadas. I have examined one specimen from Baird, in Shasta County, one from Fort Crook, and one from Berkeley, on the east side of San Francisco Bay, but from the whole great Sacramento Valley specimens are entirely lacking.

Regarding the Sierra Nevadas we have only the testimony of Mr. W. W. Price.[2] This observer obtained a specimen at Red Point, in Placer County (altitude, 4,500 feet), in the tongue of land between the north and middle forks of the American River; but he remarks also:

> The marks of moles were seen all over the high sierras [of Placer and Eldorado counties], especially about the snow fields on Mount Tallac, but no specimens were taken.

South of the Sierra Nevadas there are specimens from Los Angeles, Alhambra, San Gabriel, and the town and peak of San Bernardino, but none from east of the mountains of this region. There are none from San Diego County, but Mr. Stephens notes that the mole is common in damp lands in the county, especially in the mountains.[3]

Thus the range of the genus is carried to the southern boundary of the United States. Beyond we have only one specimen, the type of *S. anthonyi* from the San Pedro Martir Mountains, 150 miles south of the boundary, in Lower California. The collector, Mr. Thurber, reported that moles were rare.[4]

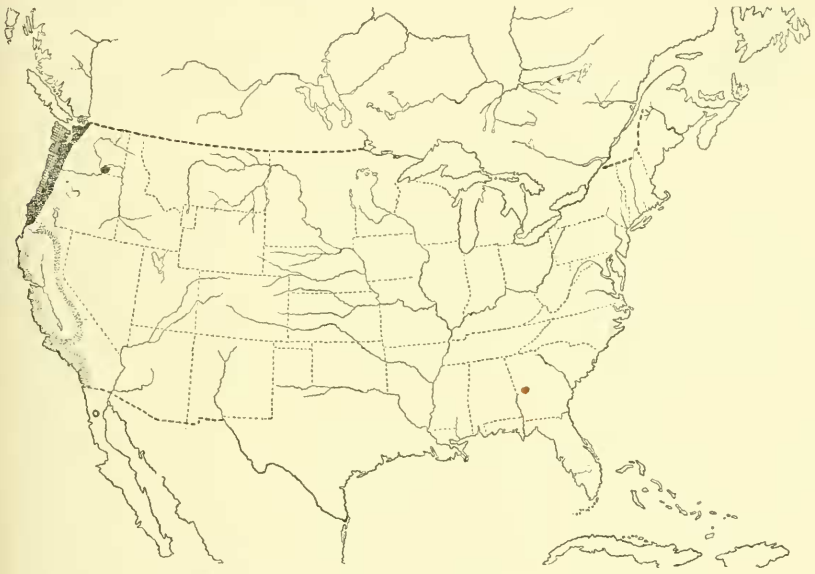
East of the Sierras in California, as already stated, specimens have been obtained in only two localities—Bijon, at the south end of Lake Tahoe, and Olancha, on Owens Lake (elevation 3,700 feet).[5] I think it probable that the mole follows the mountains westward from the latter locality along the north side of the Mohave Desert to the coast range, and also, perhaps, northward to Lake Tahoe. A specimen recently received from Tehachapi, Kern County, tends to confirm this view, so far as the western extension is concerned, while Mr. Price's observation (already quoted) is of interest in connection with the northern extension.

Of the species recognized in this work, the typical one, *S. townsendi*, ranges from the northern boundary of the United States over that

[1] Smithsonian Report, 1864, p. 424.
[2] Zoë, 4, 1893, p. 326.
[3] Stephens, West Amer. Scientist, VII, 1890, p. 39.
[4] Bull. Amer. Mus. Nat. Hist., V, 1893, p. 200.
[5] See footnote, p. 53.

portion of Washington and Oregon lying between the Cascade Mountains and coast range, and a short distance into California along the coast. The most southerly specimen examined was from Crescent City, Cal. Here the species appears to end, though it may go a little farther south. It shows no disposition to grade into *S. californicus*, which reaches up toward it. The character of the moles inhabiting the area between Crescent City and Cahto remains to be determined, but they will probably prove to be *S. californicus*.

On the seacoast of Oregon, from the Coquille River northward, on the coast of Washington, the south shore of the Straits of Fuca, and both sides of Puget Sound, we find another species, *S. orarius*, dark colored, like *S. townsendi*, but very small. This lives with *S. townsendi* at Steilacoom and probably at other points about Puget Sound. It occurs also at Chiloweyuck and Sumas, British Columbia.



GEOGRAPHICAL DISTRIBUTION OF THE SPECIES OF SCAPANUS.[1]

There is a species, as we have said, living at Fort Walla Walla, as evidenced by specimens in the National Museum collection obtained by Major Bendire. But whether it is to be associated with *townsendi* or *orarius* is uncertain. The material at command consists only of three youngish individuals in alcohol. The skull of one of these, which exhibits characters of immaturity, is larger than adult *orarius* from Sumas, but smaller than youngish *townsendi*. I am inclined to regard it as an offshoot of *orarius*, but when more specimens have been collected along the Columbia River eastward of the Sierra

[1] Cross hatching indicates *Scapanus orarius;* heavy stippling, *S. townsendi:* light stippling, *S. californicus;* and small circle in Lower California, *S. anthonyi.*

Nevadas, it may be shown that the mole of this region unites with *townsendi*, or even that *orarius* and *townsendi* merge into each other in this roundabout way.

In California, if my views are correct, there is only a single varying species, *S. californicus*. This occupies the coast country along its entire length, except perhaps, the most northerly part near the boundary. At the south it extends no farther east than the San Bernardino Mountains, and follows the higher land up to the southern rampart of the Sacramento Valley. It does not enter the valley, so far as known, but is diverted east and west: one portion of the range, as already stated, covering the coast country east of the coast range, and the other extending along the Sierras, probably throughout the whole range in suitable localities, up to Shasta County (Fort Crook, Baird, etc.), and beyond in Oregon to the Klamath Lake region. The species occurs at Owens Lake and Tahoe Lake, as already stated, both of which are on the eastern slope of the Sierras, but at considerable elevations.

South of the Mexican border we have only one species, *S. anthonyi*, and this is known only from one specimen obtained in the San Pedro Martir Mountains, at an elevation of 7,000 feet.

THE SPECIES OF SCAPANUS.

On the basis of the specimens examined, I am disposed to recognize four species of *Scapanus*. The typical species, *S. townsendi*, is a large dusky mole, with a long face. The color is much darker than is ever attained by *Scalops aquaticus* and is almost precisely that of *Parascalops*. The skull is noticeably large and massive, and the bridge of bone limiting the suborbital foramen behind is broad and depressed. The lateral unicuspid teeth are large and terete, and form a regular row. They are noticeably more widely separated from one another than in the more southern species. The interval between the first upper incisor and the last premolar exceeds 17 per cent of the total length of the skull, while in the Californian species this interval rarely reaches 16 per cent and is generally about 15 per cent. This character, together with the large size, is sufficient to separate *S. townsendi* from the Californian species. In the vicinity of Puget Sound and along the coast of Washington and northern Oregon is a second species, *S. orarius*, which is also dark colored and long-faced, and presents the cranial characters of *S. townsendi*, but is at once distinguishable by its very small size. In California we find a third species, which is distinguishable from the other two externally by its lighter color. It has a short face. It is a variable species as regards size, reaching almost the proportions of *S. townsendi* in the northern part of its range and becoming smaller than *S. orarius* at the South. It is also somewhat variable in color, as will be shown more in detail presently.

Townsend's mole, *S. townsendi*, presents very little variation either in size or color. It is as dark, or nearly as dark, at Crescent City, California, the southern limit of its range, as about Puget Sound, and it

shows no tendency toward a diminution in size at that point. The same is the case with *S. orarius*, if we except the evidence supplied by the Fort Walla Walla specimens. If these specimens represent an offshoot of *S. orarius*, as I have supposed, it may be shown hereafter that a large form of *orarius* occupies the western border of the Columbia plains.

The California mole, like the Eastern *Scalops aquaticus*, presents a wide range of variation in size. Along the northern coast we find the maximum. Toward the south there is a gradual falling off, until in the southern counties a minimum is reached. The conditions in the Sierra Nevadas, as far as can be determined from the very few specimens available, are somewhat different. In the Sierras themselves the species appears to maintain a comparatively large size throughout. Specimens from Baird, Fort Crook, and Bijou (Lake Tahoe) are about the same size as the single one from Tehachapi, at the extreme south of the Sierras, while on the other hand they are smaller than specimens from northern localities on the coast.

The specimens from Olancha, Owens Lake, elevation 3,700 feet, on the east slope of the Sierras, and considerably north of the latitude of Tehachapi, are very small, almost at the minimum, although the real minimum on the coast is found much farther south.

The variation in color in *S. californicus*, making due allowance for seasonal changes, can not be considered very great. Specimens from Los Angeles County are a little browner than those from the vicinity of San Francisco Bay, and the Owens Lake specimens, are, perhaps, paler. The only very pale specimen, however, is one from the peak of St. Bernardino, which has the fresh winter pelage. This is very silvery, and is comparable to specimens of *Scalops aquaticus* from Wisconsin.

S. anthonyi is the smallest form of *Scapanus* on the Pacific Coast and is at the point farthest south in the range. The type is an old individual, as stated by Dr. Allen, having the depressed cranium, short interparietal, and worn teeth, indicative of age. It is darker than specimens from various parts of southern California, but is about equaled by one from Pacific Grove, Mendocino County. In other respects there does not seem to be any distinction between *S. anthonyi* and ordinary California moles. Dr. Allen does not give any other characters except one relating to the dentition. The premolars are only three in each side of the upper and lower jaws. If this is constant, it forms a marked characteristic of the species. With only one specimen at hand, however, nothing can be certainly determined.

I am strongly inclined to regard this species as merely an outlying geographical race of *S. californicus*, but as material from southern California is not so abundant as could be desired, and the species itself is represented only by the type specimen, I have thought best to preserve its status as established by the describer. Those naturalists who regard isolation as a guarantee of specific distinctness will probably

continue to call it a species, as the mountain which it inhabits is cut off from more northerly ones by a considerable extent of arid territory. It is a nice question to decide how great a degree of isolation is sufficient to warrant the recognition of a species. No one will doubt, I presume, that the characters which this form presents (with the exception of that relative to the dentition) are a function of humidity and food supply.

In 1842 Bachman described a species which he called *Scalops latimanus*,[1] basing it in part on a specimen in the Berlin Museum, supposed to be from Mexico, and in part on a second specimen which he received from Texas. What the Texas specimen really was is not discoverable, but in 1864 Peters pointed out that the specimen which Bachman supposed to be from Mexico was sent to the museum from Monterey, California, by Deppe, and was collected in October, 1834, in Santa Clara. Peters seems to have been in doubt as to whether this latter locality was not in Sonora, Mexico, but probably Santa Clara, California, is the place intended. However this may be, the description of the specimen seems to indicate that it must have come from the extreme northern portion of California, or from Oregon. The color and size are not those of the mole of southern California. This being the case, it seems reasonable to regard the species as synonymous with *Scapanus townsendi*.[2]

Another nominal species is Cassin's *Scalops æneus*, based on a specimen obtained by the United States Exploring Expedition in Oregon. The type skin, No. 3725, is still in the National Museum, but the skull has disappeared. All the remarkable characters of this species, such as black claws, bronze coloration, etc., are unnatural, and suggest the conclusion (of which I think there can be no question) that the specimen was kept in a copper tank in alcohol which had attacked the walls of the tank, and held copper salts in solution. I have seen other specimens which presented the same appearance, and were known to have suffered from the same cause. Allowance being made for the discoloration, the specimen appears to be a youngish individual of typical *S. townsendi*. (I have given the measurements of the type on p. 64.)

Another nominal species is the *Talpa taeniata* of LeConte,[3] described in 1853 and based on one of the two typical specimens of *S. townsendi*, which had an irregular white mark on the belly. This specimen was collected by Townsend on the banks of the Columbia River, May 9, 1835, probably at or near Fort Vancouver, Oregon, which is also the locality from which the real type of *S. townsendi* was obtained.

The characters employed by LeConte are as follows:

Nares superni, cauda brevi parce pilosa. Cinero-nigra, pedibus pallidus, fronte vittaque inferna albis.

[1] Boston Journ. Nat. Hist., IV, 1842, p. 34.

[2] Monatsberichte der k. Preuss. Akad. Wissensch. Berlin, 1863, (1864), p. 656.

[3] Proc. Acad. Nat. Sci. Phila., VI, 1853, p. 327.

The third tooth of the upper jaw following the large incisor is more elongated than in the true Talpa Townsendii; the posterior cusps of the 7th and 8th lower teeth, although distinct, are smaller than in T. townsendii and there is no distinct internal basal margin connected with the cusp.

My study of the group leads me to believe that the peculiar coloration is merely an individual variation. The characters ascribed to the teeth could only be considered important if the teeth were unworn. The changes due to use are greater than those here employed for specific differentiation.

CHANGE OF PELAGE IN SCAPANUS.

The change of pelage in this genus appears to begin on the breast and to extend thence to the head and back and finally to the belly, on which the new hair intrudes both from the breast and the sides.

The specimens at command are not sufficient to make entirely plain the dates at which the changes begin and are completed in the several species. In southern Washington and northern Oregon the fall change of *S. townsendi*, probably begins about the first of October. One specimen from Tenino, Washington, has the entire new pelage October 19, and I may conclude that, in males at least, the molt ends about this time. In northern Oregon the change has not affected the belly at this date, so that the molt is probably not completed here before the first of November.

The dates for *S. californicus* are probably somewhat later, and in southern California the fall molt probably begins as late as November 1. In a male obtained in Marin County November 23 and a female obtained November 27, the belly still retains the old fur, so that in this part of northern California the fall molt can scarcely be completed until after the 1st of December.

In relation to the spring molt, we find the following: A specimen of *S. townsendi* from Tacoma, Washington, taken in May, has the new fur on the breast and head and along the middle of the back; there are also a number of small irregular patches of new hair on the belly.

Of *S. californicus*, a female from Nicasio, California, captured May 10, a male May 15, another male May 22, and a second female June 26, all have the appearance of having completed the molt. It is quite probable, however, that they have not yet commenced, as appears from the fact that a female from the same locality, taken May 29, has the new fur developed only on the breast, and is just starting on the head and hinder part of the back. A female from Cazadero, Sonoma County, taken July 5, has shed on the neck, head, and most of the back, but not on the rump, sides, or belly.

In this specimen the old and new fur are so closely alike in color except on the breast that the line of demarkation can only be detected by very close scrutiny. Another specimen (a female?), taken at Nicasio July 12, still has a small patch of old fur on the sides of the belly, and one from Gualala, taken July 14 (marked male, but probably female),

has shed only on the head and breast, but new fur is elsewhere concealed under the old. A female from Olancha, Owens Lake, California (altitude 3,700 feet), taken June 12, has new fur on the breast and head and along the middle of the back. In a male from San Bernardino, Cal., captured June 7, the change has gone a little further, involving nearly the entire upper surfaces and the under surfaces as far as the middle of the belly. It is rather surprising to find that a male from Alhambra, Los Angeles County, California, taken June 21, has not changed at all, the new hair reaching up only to the middle of the old, and this only on the back.

INDIVIDUAL VARIATION IN SCAPANUS.

There are two kinds of variation which may be termed "individual," one a congenital variation and the other acquired. Of congenital variation, there does not seem a great deal among the Pacific Coast moles. A specimen of *S. californicus* from Alhambra, California (a male), and one from Cazadero (a female) have a small line or tawny-white mark on the left side of the face. This probably represents incipient albinism, and is congenital.

Acquired variations in color arise from staining by secretions, fading, etc. Where these affect the whole body, it is not always easy to determine whether they are accidental or seasonal. When the lower part of the hairs, which are ordinarily pure plumbeous gray, is affected, it may, I think, be supposed that the alteration is accidental and due to external causes. Thus, three skins of *S. californicus* from Alhambra, California, exhibit large areas, on the back and elsewhere, of a bright bronzy color, which color affects, to a certain degree, the lower part of the hairs, which are far from being pure gray. A specimen of *S. townsendi* from Seaton, Oregon, taken October 5, shows a somewhat similar suffusion over nearly the whole body, though it is less conspicuous, as the Oregon moles are very dark-colored. In this instance the discolored fur is old fur, the new fur appearing at its roots.

Several specimens small show tufts here and there of fur which is whitish or tawny throughout, as is sometimes seen in *Scalops*. These spots do not seem to be due to age.

The most noticeable individual variations in the skulls are those which affect the teeth. These variations are few in number and consist in reductions of the normal number of teeth. Only four cases of this kind are to be found among the skulls which I have examined. A skull of *S. californicus* from San Gabriel, California, lacks the first upper premolar on the right side.[1] One from Nicasio lacks the third upper incisor on the left side, and another from the same locality lacks the second

[1] It is not always possible to determine the proper name of the missing tooth. When a premolar is lacking, for example, the remaining teeth frequently change their normal position, so that no large hiatus is left.

incisor on both sides. A skull from Fort Klamath, Oregon, has no first upper premolar on either side.[1]

I have not detected any reduction in the number of mandibular teeth.

AGE VARIATIONS IN SCAPANUS.

The variations depending on age which are of the most interest are those affecting the shape of the skull and teeth.

Youngish skulls, or those in which the teeth are unworn, have a high, rounded brain case and smooth surface. The sutures, from the frontals backward, are open, but these apparently are never obliterated, even in extreme old age. The facial sutures become closed at a comparatively early age, and are rarely to be distinguished in skulls with worn teeth. The sutures at the base of the cranium, on the contrary, close very early, even before the milk teeth are all shed.

As age progresses, while the inferior half of the brain case remains unchanged, the superior half becomes depressed, especially in front, where the parietals meet the frontals, so that the frontal sinuses have the appearance of being elevated.

The arcuate transverse occipital ridge, which appears to mark the union of the occipital with an interparietal, becomes more pronounced and moves forward, so that the "interparietal" is much narrower than young skulls. This change is very striking and might easily be mistaken for a specific character. The elliptical capsule which covers the superior vermis of the cerebellum becomes more prominent.

All the ridges of the skull are, of course, more strongly developed as age progresses. There is a distinct but low sagittal crest. The postero-external margin of the squamosal is thickened and the surface of the maxillæ immediately in front of the frontals is depressed.

The changes in the form of the teeth are very striking. The unicuspidate teeth are at first long, slender, and sharp, and (in northern specimens at least) separated by considerable intervals. As they become worn there is an apparent increase in size, so that the intervals between them are nearly or quite closed, and they are short and massive. The small internal and anterior basal cusps of the last upper premolar are usually obliterated, as well as the posterior cusp of the first and second premolars.

The changes in the molars are not less striking. Not only are the cusps entirely worn off in age so that the inferior or grinding surface of the teeth is nearly or quite flat, but the shape of the cusps themselves is altered. The small accessory cusps of the upper molars are obliterated, and the internal basal cusp is worn away not only at the extremity but at the sides, so that it takes a new form and is much narrower in proportion to the whole tooth than in unworn teeth.

The lower molars suffer similar changes. In the last molar the

[1] This is No. 1286, Merr. Coll., the type of my *Scapanus dilatus*. This species, based chiefly on the absence of the premolar, I now regard as invalid. (See p. 61.)

posterior lobe, which ordinarily approaches the anterior lobe in size, may be worn to a mere rounded tubercle, connected with anterior lobe by an extremely narrow bridge.

It is obvious from these facts that characters drawn from the shape of worn teeth can be of little value in distinguishing species.

As regards external characters, it may be said that those individuals in which the hairs of the tail and hind feet are brownish are young, while those which have this hair white are mature or old. Old individuals often have in addition small tufts of entirely white or whitish fur mingled with normal fur; but in some cases this appears to be merely an individual peculiarity, and is not due to age.

Very young moles appear to be much lighter and more silvery than the adults. This appearance is heightened by the circumstance that the fur (at least in dry skins) is closely appressed and the surface color is not clouded by intermixture with the dark color of the basal portion of the hairs.

SEASONAL DIFFERENCES IN COLOR IN SCAPANUS.

Between the fresh winter and summer pelages there is not so much difference in color as might be expected. The winter fur is usually darker and grayer, while the summer fur is paler and has more of a reddish tinge. Worn pelage is pale and faded and often suffused with dull yellowish. There is not that sharpness of boundary between the brown tips of the hairs and the plumbeous lower portion which exists in new fur. In some instances, however, the old and new fur are so closely alike in color that the boundary between them can only be detected by the closest scrutiny.

HISTORY OF THE SPECIES OF SCAPANUS.

The occurrence of moles on the Pacific Coast was known to Lewis and Clarke,[1] whose expedition was undertaken at the beginning of the present century, and perhaps to earlier explorers, but they were first given a place in scientific nomenclature by Richardson, in 1829,[2] who called the species "*Scalops canadensis* (Cuvier)." Cuvier did not really use this Latin name for any species, but did apply its French equivalent, "Scalope du Canada,"[3] to the Eastern mole, *S. aquaticus*. Richardson supposed that the two moles were specifically the same, and remarks:

> The Columbia animal [*Scapanus townsendi*] seems to be of larger dimensions, and has a longer tail than the Shrew moles of the United States [*Scalops aquaticus*]; but I have not detected any other peculiarities by which it might be characterized as a distinct species.[4]

[1] See the History of the Expedition of Lewis and Clarke, Paul Allen, editor, II, 1814, p. 178.

[2] Richardson, Fauna Boreali Americana, Mammalia, 1829, p. 9.

[3] Règne Animal, 1st ed., I, 1817, p. 135.

[4] Richardson, loc. cit., p. 11.

His description, however, is strictly applicable to *Scapanus townsendi*. It would be necessary to use the name *canadensis* for the northern Pacific Coast mole were it not that other writers applied this latinized form of Cuvier's appellation at an earlier date to *Scalops aquaticus*—namely, Desmarest in 1820, and Harlan in 1825.

We must, therefore, seek out the next name used for our northern Pacific Coast species, which is Bachman's *Scalops townsendii*, established in 1839.[1] Bachman had two specimens, one of which was given him by Nuttall and the other he subsequently received from Townsend. The former is the type. Exactly where it was captured is not stated in connection with the original description, but later Bachman[2] remarked that he believed that it was from the same locality as Townsend's specimen. The latter was from the "banks of the Columbia River, May 9, 1835." At this date Nuttall and Townsend were together on the Columbia, at Fort Vancouver, or at Warrior's Point, about 20 miles down the river, having recently returned from a voyage to the Sandwich Islands. It may be assumed, therefore, that the locality of the type was Fort Vancouver, or the immediate neighborhood.

In 1842, when reviewing the genus *Scalops*, Bachman described another western species,[3] *S. latimanus*, basing it on a specimen in the Berlin Museum, which he supposed to have been obtained in Mexico, and one he had received from Texas. Peters afterwards[4] showed that the specimen supposed to be from Mexico was a *Scapanus*. I have considered the species somewhat at length in another place (p. 58), and am disposed to regard it as identical with typical *S. townsendi*.

In 1848, Pomel took *S. townsendi* out of the genus *Scalops* and established the genus *Scapanus* for its reception.[5]

Somewhat later, in 1853, Cassin published a description of what appeared to be a very remarkable new species from a specimen, *Scalops æneus*, obtained in Oregon by the United States Exploring Expedition.[6] It appears from an examination of the type, however, that the striking peculiarities of the type specimen are due to its having been kept for a long time in a copper tank. The skull has disappeared, but there is little reason to doubt that the specimen is only a rather young *Scapanus townsendi*.

When describing *Scapanus townsendi*, Bachman had before him, as already stated, two specimens, one of which (Townsend's specimen) had an irregular white mark on the under side of the body. In 1854, Le Conte, thinking that he detected certain other peculiarities in this specimen, described it anew under the name of *Talpa taeniata*.[7] For

[1] Journ. Acad. Nat. Sci. Phila., VIII, pt. 1, 1839, p. 58.
[2] Boston Journ. Nat. Hist., IV, 1842, p. 32.
[3] Boston Journ. Nat. Hist., IV, 1842, p. 34.
[4] Monatsber. Berlin Akad. für 1863 (1861), p. 656.
[5] Archiv. Sci. Phys. et Nat., IX, 1848, p. 247.
[6] Proc. Acad. Nat. Sci. Phila., VI, 1853, p. 299.
[7] Proc. Acad. Nat. Sci. Phila., VI, 1853, p. 327.

this course, however, there does not seem to have been sufficient warrant, and the name should stand as a synonym of *S. townsendi*.

All the names thus far considered are to be regarded as synonyms of *S. townsendi*, but in 1855 Dr. W. O. Ayres described the mole which is found in the neighborhood of San Francisco, California, under the name of *Scalops californicus*.[1] This is a smaller and paler form than the typical Oregon mole, and is recognized as a distinct species, *S. californicus*, in this work. Whether a type specimen was preserved is uncertain, but about 1856 Dr. Ayres sent two specimens to the National Museum from San Francisco,[2] which may be regarded as typical.

Dr. J. A. Allen established a species under the name of *Scapanus anthonyi*, in 1893, from a specimen obtained in the San Pedro Martir Mountains of Lower California.[3]

The type remains unique, and until more specimens are collected from the same and other neighboring localities the relationships of the species can not be fully determined.

In 1894 I described, under the name of *S. dilatus*,[4] a supposed new species, characterized, like *S. anthonyi*, by the possession of one less upper premolar than the usual number, and some other minor features. This species was based on a skeleton from Fort Klamath, Oregon, belonging to Dr. C. H. Merriam. Afterwards, Dr. Merriam sent me two other specimens in alcohol, from the same locality. These had the normal number of premolars. Such being the case, I am disposed to regard the other characters given in the diagnosis as individual rather than specific, and to associate the Fort Klamath mole with *S. californicus*.

DESCRIPTION OF THE TYPE SPECIMEN OF SCALOPS ÆNEUS, CASSIN.

No. 3725, U.S.N.M., Oregon, U. S. Explor. Exped.

The type is a skin without a skull. It is in a good state of preservation except for its discoloration from immersion in impure alcohol.

From its small size and long claws, it may be judged to be a young individual. It measures as follows:

	mm.
Length of head and body	115.0
Length of tail	30.5
Length of fore foot (without claws)	11.0
Length of longest foreclaw	10.0
Length of hind foot (without claw)	21.5
Length of longest hind claw	4.5

REMARKS OF PROFESSOR PETERS ON THE TYPE SPECIMEN OF SCALOPS LATIMANUS, BACHMAN.

"6. *Scalops latimanus* Bachmann = *Sc. Townsendi* Bachman, Baird.

"Diese Art ist von Bachmann nach einem Exemplar des Berliner

[1] Proc. Cal. Acad. Nat. Sci., I, 1855, p. 54.

[2] Skeleton, No. 3111; alcoholic, No. 2673. The latter is mentioned by Baird.

[3] Bull. Amer. Mus. Nat. History, V, 1893, p. 200.

[4] Proc. U. S. Nat. Mus., 17, p. 242.

Museums aufgestellt worden, welches von Deppe angeblich aus Mexico eingesandt worden wäre. Das einzige Exemplar der Gattung *Scalops*, welches sich aber aus der Deppe'schen Sammlung im Berliner Museum (No. 712) befunden hat und befindet und welches, da ich es als '*Sc. latimanus* Bachmann' bezeichnet vorfand, ohne Zweifel das Originalexemplar der Bachmann'schen Art ist, stammt nicht aus Mexico, sondern ist, wie aus dem Eingangsjournal der Deppe'schen Sammlung hervorgeht, aus Monterey in Californien eingesandt und im October 1834 in Sta. Clara (Sonora?) gesammelt worden. Es gehört dieses Exemplar auch nicht zu der eigentlichen Gattung *Scalops*, sondern zu *Scapanus* Baird mit 44 Zähnen und stimmt nicht allein nach Baird's genauer Beschreibung, sondern auch nach Vergleichung mit einem zweiten Exemplar, welches wir Hrn. Dr. F. Jagor aus Californien verdanken, durchaus mit *Sc. Townsendi* überein. Es muss daher der *Sc. latimanus* aus der Liste der Säugethiere gestrichen werden."[1]

DESCRIPTION OF THE TYPE SPECIMEN OF SCAPANUS ANTHONYI.

J. A. ALLEN.

No. $\frac{6303}{4047}$. Male. San Pedro Martir Mt., L. Cal. (altitude 7,000 ft., May 8, 1893). Collection of American Museum of Natural History.

This specimen is a well-prepared skin accompanied by a skull. The fur is rather dark and fresh-looking, giving the impression that it is the new summer pelage.

The skull has but three premolars above and below. The first premolar is apparently the one missing. Whether this difference is merely an individual peculiarity can not, of course, be determined until more specimens shall have been collected. The teeth are much worn, and the contour of the skull indicates that it is mature or old.

The dimensions of the skull are as follows:

	mm.
Total length	30.0
Basilar length	24.7
Palatal length	13.5
Mastoid breadth	15.7
Zygomatic breadth	12.8
Facial breadth	8.8
Breadth between I^1 and PM^3	4.6

[1 Translation.]

"6. *Scalops latimanus* Bachman = *Sc. Townsendi* Bachman, Baird.

"This species was based by Bachman on a specimen in the Berlin Museum which had been forwarded by Deppe nominally from Mexico. The only specimen of the genus *Scalops*, however, from Deppe's collection which has been and is in the Berlin Museum, No. 712 (and which, as I found it marked as '*Sc. latimanus* Bachmann,' is doubtless the original specimen of Bachman's species), did not originate from Mexico, but was, as appears from the entry journal of Deppe's collection, transmitted from Monterey in California, and was collected in Santa Clara (Sonora?) in October, 1834. This specimen does not belong to the genus *Scalops* proper, but to *Scapanus* Baird, with 44 teeth, and agrees, not only according to Baird's exact description, but also according to a comparison with a second specimen from California, which we owe to Dr. F. Jagor, entirely with *Sc. Townsendi*. Hence the *Sc. latimanus* must be stricken out of the list of mammals." (Monatsber. K. Akad. Wissensch. Berlin, 1863, p. 656.)

The skin as now preserved has the following dimensions:

	mm.
Total length	124.0
Length of tail	28.5
Breadth of fore foot	12.5
Length of fore foot (without claw)	12.0
Length of hind foot (without claw)	15.5

Dimensions of skulls of Scapanus orarius.

Catalogue number. Skull.	Skin.	Collection.	Locality.	Sex.	Total length.	Basilar length (Hensel).	Length of palate from in front of incisor.	Mastoid breadth.	Greatest zygomatic breadth.	Greatest facial breadth.	Interval between first upper incisor and last premolar.	Age.
					mm.	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	
5208	4555	Merriam....	Port Townsend, Wash.	...	33.0	27.2	14.4	.....	12.6	9.2	5.8	Youngish.
		Miller	Sumas, British Columbia.									
43329	31464	Dept. Agric.	Steilacoom, Wash..	♂	32.6	26.6	14.1	16.0	13.0	9.5	5.6	Adult.
22650	.....	Nat. Mus ...	Myrtle Point, Oreg.	♀	33.7	27.6	14.6	16.5	12.6	9.5	6.0	Youngish.
36937	15065	Nat. Mus ...	Fort Walla Walla, Wash.	...	32.8	26.8	14.4	16.0	13.0	9.8	5.2	Do.

Dimensions of skulls of Scapanus townsendi.

					mm.	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	
6894	.....	Nat. Mus...	Simiahmoo, Wash..	...	40.5	.....	18.7	19.2	15.3	10.7	7.1	Adult.
42810	30918	Dept. Agric.	Sauk, Wash	...	41.2	35.0	18.2	19.6	15.4	11.6	7.4	Do.
43332	31467	.....do	Tenino, Wash	♀	41.2	34.0	18.7	19.2	16.0	11.3	7.1	Oldish.
43330	31465	.....do	.....do	♂	41.4	34.5	19.0	19.1	16 0	11.8	7.5	Adult.
43331	31466	.....do	.....do	...	41.0	34.2	18.0	19.7	15.8	11.7	7.2	Do.
66199	.....	.....do	Lake Cushman, Wash.	♂	40.7	34.0	19.0	19.4	15.6	11.9	7.3	Do.
66200	.....	.....do	.....do	♂	40.5	34.2	18.5	19.4	15.6	11.2	7.0	Do.
2050	1438	Merriam....	Skokomish, Wash..	...	39.2	32.4	18.2	18.5	15.4	11.0	7.3	Do.
56896	.....	Dept. Agric.	Oregon City, Oreg..	♂	41.5	34.6	19.0	20.0	16.2	12.0	7.5	Do.
56897	.....	.....do	.....do	♂	41.3	34.5	18.4	20.0	16.4	11.6	7.2	Do.
57140	.....	.....do	Beaverton, Oreg.....	...	41.7	34.5	18.5	20.0	16.4	12.2	7.3	Do.
36525	21831	Nat. Mus ...	Salem, Oreg.....	...	39.0	.....	17.5	19.3	16.3	11.3	6.7	Do.
69400	.....	Dept. Agric.	Seaton, Oreg	♀	43.8	36.4	19.4	20.2	15.8	12.0	8.0	Old.
68150	.....	.....do	Crescent City, Cal .	♂	.....	.....	19.2	.....	16.6	10.6	8.0	Adult.

Dimensions of skulls of Scapanus californicus.

					mm.	*mm.*	*mm.*	*mm.*	*mm*	*mm.*	*mm.*	
68149	.....	Dept. Agric.	Gualala, Cal.....	...	37.2	31.2	16.4	17.2	14.3	10.3	6.1	Adult, or less.
60148	.....	.....do	Cazadero, Cal	♀	37.2	30.5	16.4	17.3	.....	10.9	6.2	Adult.
548	1285	Amer. Mus .	Nicasio, Cal.....	♀	37.4	31.4	16.7	17.6	14.7	10.9	5.2	Old.
65195	.....	Dept. Agric.	.....do	♀	36.0	30.0	16.0	17.0	14.0	10.0	5.6	Do.
547	1284	Amer. Mus .	.....do	♂	37.4	31.0	16.2	17.3	14.8	10.4	5.7	Old, or less.
65193	.....	Dept. Agric.	.....do	♀	36.3	29.2	15.6	17.4	14.6	10.6	5.5	Do.
65194	.....	.....do	.....do	♂	37.0	30.0	16.2	17.2	14.6	10.4	5.5	Do.
3361	2731	Merriam....	.....do	♂	35.0	28.3	14.4	17.0	.....	10.2	6.4	Adult.
509	1080	Amer. Mus .	.....do	♀	36.4	30.0	15.6	17.3	14.4	10.6	5.4	Do.
65192	.....	Dept. Agric.	.....do	♀	37.5	30.8	16.4	17.0	14.4	10.0	6.2	Do.
65191	.....	.....do	.....do	♀	37.0	30.0	16.3	17.0	14.5	10.2	5.9	Do.
65189	.....	.....do	.....do	...	36.3	30.3	15.6	16.4	13.5	9.6	6.0	Adult, or less.
65187	.....	.....do	.....do	♂	36.0	29.5	15.5	17.0	14.0	10.0	5.8	Do.
35285	19877	Nat. Mus ...	.....do	♂	36.8	31.0	16.0	17.2	14.3	10.0	6.0	Do.
35286	19829	.....do	.....do	♀	34.5	29.5	15.4	17.6	14.4	10.0	5.6	Do.

Dimensions of skulls of Scapanus californicus—Continued.

Catalogue number.		Collection.	Locality.	Sex.	Total length.	Basilar length (Hensel).	Length of palate from in front of incisor.	Mastoid breadth.	Greatest zygomatic breadth.	Greatest facial breadth.	Interval between first upper incisor and last premolar.	Age.
Skull.	Skin											
					mm.	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	
35128	19409	Nat. Mus ...	Nicasio, Cal.....	♂	37.0	29.6	16.0	17.4	14.0	10.6	5.3	Adult, or less.
3956	3291	Merriam....	.....do	♀	35.0	29.0	15.0	17.0	14.0	10.4	5.4	Do.
6130	5443	.....do	Berkeley, Cal	♀	36.3	31.8	15.6	17.6	14.7	10.8	5.4	Do.
3111	.....	Nat. Mus ...	San Francisco, Cal. ...	♂	32.7	27.0	14.0	16.5	13.7	10.0	5.0	Adult.
48391	36047	Dept. Agric.	Pacific Grove, Cal..	♂	33.6	27.7	15.0	16.1	13.4	9.5	5.3	Youngish.
30299	.....	.....do	Alhambra, Cal.....	♂	30.0	....	14.2	16.0	13.0	9.4	5.0	Adult.
30298	.....	.....do	.....do	♂	31.8	27.0	14.2	16.2	13.6	9.8	5.0	Adult, or less.
30300	.....	.....do	.....do	♂	30.3	25.4	13.3	15.2	12.6	9.2	4.8	Do.
61374	.....	Nat. Mus ...	.....do	♂	32.0	26.7	14.0	16.0	13.0	9.0	5.2	Do.
30406	.....	Dept. Agric.	.....do	♂	30.8	25.2	13.4	15.7	13.0	9.3	5.0	Youngish.
30411	.....	.....do	.....do	♂	31.7	26.7	14.2	15.8	12.9	9.1	5.1	Do.
30310	.....	.....do	San Gabriel, Cal ...	♂	32.0	26.1	13.4	15.3	13.0	9.0	4.8	Adult, or less.
2746	2230	Merriam....	San Bernardino, Cal	♂	30.6	25.0	13.0	15.7	13.0	9.4	4.8	Do.
56533	.....	Dept. Agric.	San Bernardino Peak, Cal.	♂	32.3	26.8	14.0	16.3	13.5	9.7	4.6	Old.
66597	.....	.....do	Tehachapi Peak, Cal.	♂	.....	27.3	14.4	16.6	13.7	10.0	5.4	Adult, or less.
41243	.....	.....do	Owens Lake, Cal...	♀	31.6	25.6	13.7	15.8	13.2	9.6	4.9	Do.
40943	.....	.....do	.....do	♀	31.0	24.4	13.4	15.4	12.5	9.4	4.9	Youngish.
23967	.....	.....do	Bijou, Cal.....		.....	.....	15.0	.....	.....	9.6	5.8	(Broken.)
	11243	Nat. Mus ...	Fort Crook, Cal.....		33.8	27.5	.....	16.9	14.0	10.0	5.4	Youngish.
36886	14475	.....do	Baird, Cal.....		.....	.....	15.4	16.9	.....	9.5	5.8	Do.
*1286	.....	Merriam....	Fort Klamath, Oreg		34.4	28.4	15.0	17.0	14.0	10.6	5.6	Adult.

*Type of *S. dilatus*.

Dimensions of type skull of Scapanus anthonyi.

4947	6313	Amer. Mus.	San Pedro Martir Mountains, Lower California.	♂	30.0	24.7	13.5	15.7	12.8	8.8	4.6	Adult.

Genus PARASCALOPS, True.

Parascalops, True, Proc. U. S. Nat. Mus., XVII, 1894, p. 242. (Type: *Scalops breweri*, Bachman.)

Body fusiform. Head conical. Nostrils lateral. Fore feet very broad, talpoid. Tail thick and hairy. Eyes minute. Auricular orifice large. Skull depressed; tympanic bullæ annular. Molars with a broad, trilobed internal basal lobe. Pelvis with no osseous bridges connecting the sacrum with the ischium.

Dental formula: i, $\frac{3}{3}$; c, $\frac{1}{1}$; pm, $\frac{4}{4}$; m, $\frac{3}{3}$; total, 44.

From a detailed comparison of the skeletons of *Scalops aquaticus*, *Scapanus townsendi*, and *Scapanus breweri* (or *americanus*) I arrived at the conclusion that the last two can not properly be included in the same genus, and that Townsend's mole really has a much closer affinity

with *S. aquaticus* than with *S. breweri*. In an earlier paper I separated Brewer's mole under the generic name of *Parascalops*.[1]

The characters which I rely on in making this redivision are to be found in the pelvis, the tympanic bullæ, and the teeth. Upon comparing the pelvis of the three species mentioned, it will be observed that in *Scalops aquaticus* and *Scapanus townsendi* the lateral processes of the sacral vertebræ have united with the ischium in two places, the first opposite the acetabulum and the second more posteriorly. In front of the first bridge on either side is a large oval vacuity or foramen. In addition the spines of the sacral vertebræ in these two species are completely anchylosed together, forming one continuous ridge of bone (as shown in fig. 1).

Turning to *Parascalops breweri* we find that the sacral vertebræ have no osseous connection with the pelvis posterior to the acetabula, and further that the neural spines, though connected at their extremities by a continuous bar of bone, have vacuities between them, so that the several vertebræ are readily distinguishable.

In *Scalops aquaticus* and *Scapanus townsendi* the tympanic bullæ are complete, and end externally in a small but well-formed bony meatus. Quite different conditions obtain in *Parascalops breweri*, in which the bullæ are irregularly annular and do not conceal the tympanum or form a meatus.

Finally, in *Scalops aquaticus* and *Scapanus townsendi* the crowns of the molar teeth consist of two large V-shaped external cusps, with a simple internal basal projection surrounding the internal edge of the anterior one.

In *P. breweri* the basal projection is trilobed and bounds the inner edge of both external cusps.

On the basis of these characters alone it would be necessary to unite *S. aquaticus* and *S. townsendi* in the same genus *Scalops*.[2] But the dental formula of *S. aquaticus* (together with the relative size and position of the teeth) differs from that of *Scapanus townsendi*, and the genus should be retained.

PARASCALOPS BREWERI (Bachman).

BREWER'S MOLE; OR HAIRY-TAILED MOLE.

Scalops breweri, Bachman, Boston Journ. Nat. Hist., IV, 1842, p. 32.
Scapanus breweri, Pomel, Arch. Sci. Phys. et Nat., IX, 1848, p. 247.
Scapanus americanus, Coues, Amer. Nat., XIII, 1879, p. 189.
Parascalops breweri, True, Proc. U. S. Nat. Mus., XVII, 1894, p. 242.

Size moderate (average length about 177 mm.). Snout acute; nostrils lateral, crescentic. Auricular orifice large, about 3.5 mm. in diameter.

[1] Proc. U. S. Nat. Mus., XVII, 1894, p. 242.

[2] See the statement of Flower and Lydekker: "The right [of *Scapanus*] to generic distinction is doubtful." (Mammals, p. 630.)

Tail short, very thick, blunt, densely hairy and constricted at the base. Toes not webbed.

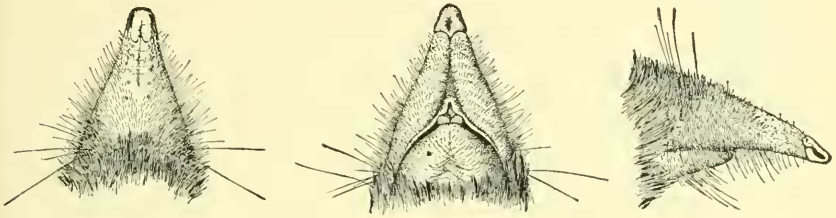
Color dusky brown, paler and grayer below. Hairs of the feet, tail, and snout brown, changing with age to white.

Average dimensions (10 adults from Magnetic City, North Carolina): Length of head and body, 146.9 mm.; tail vertebræ, 30 mm.; hind foot, 19 mm.

Average dimension of skull (20 adults): Total length, 32.2 mm.; mastoid breadth, 14.7 mm.; length of superior tooth row, 13.6 mm.

DESCRIPTION.

Body fusiform. Legs enveloped in the integuments nearly to the wrists and ankles. Head depressed and triangular, produced into a conical snout. Snout extending about 9 mm. beyond the incisor teeth;



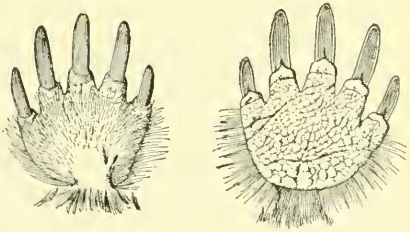
19. 20. 21.

SNOUT OF PARASCALOPS BREWERI.

Fig. 19, Upper surface. Fig. 20, Lower surface. Fig. 21, Side view.

($1\frac{1}{3}$ times natural size.)

naked above, furnished on the sides with warts, of which there are three or four on each side of the median line. Mystacial bristles prominent, the extremities of the longest extending to a point between the eyes and auricular orifice. Nostrils terminal, subcrescentic, situated on the sides of a fleshy, granular pad. Upper lip thin and ridge-like, as in *Scalops aquaticus;* emarginate in front and joined to a narrow, triangular, naked area, which runs the length of the snout inferiorly. The median line of the lower jaw also naked.



22. 23.

FORE FOOT OF PARASCALOPS BREWERI.

Fig. 22, Upper surface. Fig. 23, Lower surface.

($1\frac{1}{3}$ times natural size.)

Front feet very broad, depressed; their length (without the claws) about equal to their breadth. Upper surface sparsely covered with rather long hairs, which form a prominent fringe posteriorly; the last joint of the digits naked. Inferior surface naked throughout and granular. Toes very short, subequal, not webbed. Second, third, and

fourth claws subequal and longest; first and fifth, equal and much shorter. Claws long, thick, blunt; convex above, flat or concave below.

Hind feet narrow, about three times as long as broad; their length exceeding that of the fore feet. Upper surface hairy; sole obtusely granular, with one well-defined tubercle about in the middle of their length.

Toes short, subequal, the first and fifth much farther back than the other three and with shorter claws. Claws compressed and pointed.

24. 25.

HIND FOOT OF PARASCALOPS BREWERI.

Fig. 24, Lower surface. Fig. 25, Upper surface.

(1⅓ times natural size.)

Tail two-thirds the length of the head, thick, cylindrical, constricted at the base and well clothed with long hairs, which nearly conceal the skin.

26.

TAIL OF PARASCALOPS BREWERI.

Natural size.)

Eyes concealed in the fur, minute, and covered by membrane. No external ear; auditory orifice comparatively large (about 3.5 mm. long); much larger than in *Scalops aquaticus;* oblong, with the long axis directed obliquely downward anteriorly.

Character of the fur as in *Scalops aquaticus.* General color dark brown, with grayish and silvery reflections; darker and browner than in *Scalops aquaticus.* Under surfaces a little lighter than the upper surfaces. Tail, backs of feet, and base of snout dark brown, changing with age to mingled brown and white, and finally to pure white. Claws, pale.

Young, silvery gray, with dusky feet and tail.

Adult males with a more or less pronounced rusty suffusion around the wrists and at the extremity of the lower jaw.

SKULL.

Skull depressed and conical. Occipital broad, well advanced on the upper surface of the skull. Parietal very large and broad, triangular, more or less acute anteriorly. Frontals convex, narrowed anteriorly, and extending a considerable distance along the nasals, but not joining the premaxillæ; their lateral extensions form almost the entire anterior part of the orbital region. Nasals elongated, wedge shaped; their posterior half extending backward between the frontals, almost to the parietals; anterior extremities obliquely truncated and overlaid by the premaxillæ so as to appear very narrow in adult skulls. Lachrymal linear. Palatal surface of maxillæ concave, with a sagittal median groove. Palate emarginate behind, terminating opposite the last molar. Pterygoid process small. Basisphenoid inflated. Tympanics annular. Zygomatic arch slender, directed obliquely upward posteriorly.

Infraorbital foramen large, bounded posteriorly by a very slight bar of bone. Lachrymal foramen large, situated in front of and above the infraorbital. Horizontal ramus of mandible curved upward anteriorly and downward posteriorly. Coronoid process quadrate, with straight posterior margin. Angle similar but smaller.

TEETH.

Dental formula: i, $\frac{3}{3}$; c, $\frac{1}{1}$; pm, $\frac{4}{4}$; m, $\frac{3}{3}$; total, 44.

First superior incisor very large, broad, and flattish: somewhat inclined inward and connivent at the inner angle, notched in the middle and furnished with a small but distinct external accessory cusp. Second and third incisors, canine, and first and second premolars simple, conical, slightly curved, and compressed. Third premolar similar, but with a small compressed posterior accessory cusp. The canine is the largest of these simple teeth and the first premolar the smallest; the second and third premolars are successively larger. The second and third incisors are similar, but the third is larger than the second. The fourth premolar is large, triangular, compressed, with a small anterior accessory cusp, a posterior trenchant margin terminating in a basal tubercle, and an internal basal cusp, or heel, which is bifid. The first molar is largest, the second intermediate, and the third smallest. They are furnished with large W-shaped external cusps as in the other genera and a prominent internal basal ledge, which is trilobed (or quadrilobed in the first molar). In the last molar the posterior portion of the external cusp is aborted.

The first lower incisor is similar to the upper one but smaller. The six succeeding teeth—namely, the second and third incisors, the canine, and the first, second, and third premolars—are simple and conical. All are subequal except the second incisor, which is larger and canine-like with an anterior trenchant margin. The premolars have obsolete basal tubercles. The fourth premolar is similar to the others, but furnished with more conspicuous anterior and posterior tubercles and a similar internal one. The first and second molars are equal in size and the third about one-third smaller. The are W-shaped in transverse section.

The internal cusps are very prominent. The first molar has a distinct postero-internal basal tubercle, and the second molar similar tubercles both anteriorly and posteriorly. The anterior internal cusp of the first molar is bilobed.

SKELETON.

The vertebral formula of *Parascalops breweri*, as determined from a skeleton in the National Museum collection, and two others in the collection of Dr. Merriam, is as follows: c, 7; d, 13; l, 6; s, 6; ca, 13; total, 45. The last caudal is rudimentary.

There are eight intervertebral ossicles, the most anterior of which is

between the last two dorsal vertebrae, and the most posterior between the last lumbar and first sacral.

The sternum comprises 6 segments including the manubrium. The latter is as long as the remaining segments combined, and has the facets for the first pair of ribs at the beginning of its posterior third. The keel is broad, especially anteriorly. The upper surface is broad in front of the ribs, and furnished with a median crest.

The humerus is about one-third longer than broad, while the clavicle is equally as long as broad.

The bones of the pelvis are approximated under the acetabula, but those of the two sides do not meet. The pubic bones are widely divergent posteriorly. The iliac bones are completely fused with the sacral vertebrae above, leaving only two small foramina on each side. The last sacral vertebra has a short broad transverse process (as in *Condylura*), which does not touch the pelvis.

In the manus the *os falciforme* is short and very broad at the base. Its distal end rests against the proximal end of the first metacarpal. The terminal phalanges are irregularly bifid.

Tibia one-sixth longer than the femur; the fibula uniting with it slightly above its middle point.

GEOGRAPHICAL DISTRIBUTION.

On the basis of the specimens and records examined, the range of the species may be stated to extend from the mountains of North Carolina and West Virginia and southeastern Ohio in a northeasterly direction across Pennsylvania, New Jersey, New York, and the New England States to New Brunswick. The northwestern boundary skirts Lake Erie and Lake Ontario and follows thence the St. Lawrence River to Quebec and perhaps to the ocean; but for want of definite records as regards New Brunswick, it must be deflected southward to follow the eastern boundary of Maine, with a slight inclination outward at Passamaquoddy Bay to include Charlotte County, New Brunswick.

The specimens examined are, with two exceptions, all from localities within the following boundaries: Beginning at Cleveland, Ohio, the line skirts the southern shore of Lake Erie and of Lake Ontario to a point near the exit of the St. Lawrence River; thence it passes across New York to Lake George; thence across extreme western Massachusetts to northwestern Connecticut; thence in a southwesterly direction across Pennsylvania to the vicinity of Pittsburg; and thence to the starting point, Cleveland, Ohio. The two outlying points from which specimens have been examined are Quebec, Canada, and Magnetic City, North Carolina, at the foot of Roan Mountain.

From the records the range, as indicated above from specimens, receives large extensions, chiefly toward the northeast. The North Carolina locality is connected with the main area through the record of Audubon and Bachman. They report having seen one near Red Sulphur

Springs, West Virginia, and obtained specimens in western Virginia.[1] Mr. Bangs's collection contains several specimens from White Sulphur Springs, West Virginia. To the west, the next records which I have found are those of Langdon[2] and Brayton,[3] who report that a specimen was taken at Rome, in Adams County, Ohio, and that the species is not rare in that locality.

Mr. E. W. Vickers sent a specimen to the National Museum from Ellsworth, Ohio, and stated in a letter to me that he had also taken the species at Berea and Canton. He remarks:

> This mole seems to take the place of the common mole, *S. aquaticus* or *S. argentatus*, in the localities where I have lived—viz, Canton, Berea, and Ellsworth—for I have never taken a specimen of these species.

Dr. J. A. Allen mentions a specimen from Hollidaysburg, Pennsylvania, which is in the Museum of Comparative Zoology, Cambridge, Massachusetts. This locality is in Blair County, in the mountains near Altoona. There are no records of the occurrence of the species in eastern Pennsylvania, but Dr. Abbott mentioned it in 1868 among the mammals of New Jersey. He remarks that it "is much less abundant than the preceding [*Scalops aquaticus*], to which it bears a great resemblance."[4]

No specimens are referred to, and I know of none from the State in any museum. It would seem, therefore, that the occurrence of the species in New Jersey requires confirmation.

All the New York specimens examined were from Lewis and Oneida counties, in the northwestern part of the State, but Bachman had 4 specimens from Troy, Rensselaer County.[5] Baird remarks that the species "is in reality very abundantly to be met with in the northern part of the State, and apparently to the exclusion of the more southern species with white naked tail, *S. aquaticus*."[6] No specimens have been taken in any part of southern or southeastern New York, so far as I am aware.

The type of the species came from Marthas Vineyard, Massachusetts, and Dr. J. A. Allen mentions a specimen from Warwick, Franklin County, as being in the Museum of Comparative Zoology.[7] Dr. Coues records its occurrence at Somerset, in Bristol County.[8]

If there are any records of the occurrence of the species in Vermont or New Hampshire, they are unknown to me, but it is very probable that this mole is found there.

I have examined no specimens from Maine and know of but one

[1] Quadrupeds of North Amer., II, 1851, p. 175.
[2] Ohio Geol. Surv. Rept., IV, 1882, p. 93, 94.
[3] Journ. Cincin. Soc. Nat. Hist., III, 1880, p. 302.
[4] Geol. Surv. of New Jersey, 1868, p. 752.
[5] Aud. & Bach., Quad. of North Amer., II, p. 175.
[6] Fifteenth Rept. N. Y. State Cabinet of Nat. Hist., 1862, Appendix A.
[7] Bull. Mus. Comp. Zool., I, No. 8, 1869, p. 222.
[8] Amer. Nat., XIV, 1880, p. 53.

mention of its occurrence in the State. This was at Upton, in Oxford County, near the western boundary.[1] It probably occurs, however, generally in the State.

Two writers affirm the existence of the species in New Brunswick—Tyrrell,[2] who mentions no localities, and Chamberlain,[3] who states one specimen was taken in Charlotte County in the extreme southwestern part of the Province.

VARIATION.

In the small series at hand, in which the majority of the specimens are from Locust Grove, Lewis County, New York, Ravenna, Ohio, and Magnetic City (foot of Roan Mountain), North Carolina, no appreciable geographical variation of color or size can be detected. A specimen

GEOGRAPHICAL DISTRIBUTION OF PARASCALOPS.

from Quebec is not different from the others, except that it is a little duller in color and browner, probably due to its having been in the collection for a long time.

There is, however, considerable variation with age. The feet, tail, and base of snout, which are dark brown in young individuals, become progressively more hoary with increasing age and are eventually pure white. In all the specimens in which the tail is hoary, the teeth are more or less worn, and sometimes very greatly. The specimen which shows this albinism most strongly (No. 510, Merr. Coll., Locust Grove, New York), has stronger ridges on the skull than any other in the series.

[1] In Museum of Comp. Zoology. See J. A. Allen. Bull. Mus. Comp. Zool., I, No. 8, 1869, p. 222.

[2] Proc. Canad. Inst., 3 ser. VI, 1888, p. 89.

[3] Bull. Nat. Hist. Soc. New Brunswick, X, 1892, p. 32.

This specimen presents a very peculiar appearance, as it has the tail entirely white, whitish feet, and a white band around the base of the snout, while the body is of the usual dusky color.

The specimens from North Carolina exhibit this hoariness less strongly, but few of them show indications of age. The individuals from Ohio show the variation no less than the others, so that it is quite certain that the change is not local.

Many adult males show a rusty color on the under surfaces, especially on the breast and throat, and also around the wrists. These specimens remind one of the series of *Scalops aquaticus texanus* from Rockport, Aransas County, Texas, in which a similar suffusion is strongly pronounced. The white spots in the fur, mentioned by Professor Baird,[1] are to be found on the older individuals.

Of the thirty-two skins from Magnetic City, North Carolina, three have small areas of pure white hair on the breast. Two of these specimens are females and the third a male. This last has a longitudinal white mark on the median line of the muzzle, which ends abruptly in a small orange-colored spot; the white on the breast in this instance is followed by an area of dull orange-brown; in fact, the base of the hair all around the white area is of this color.

MOLTING.

I have been able to make out very little regarding the shedding of the fur in this species from the series of about fifty specimens at command. Only three specimens show indications of shedding, and the condition of the fur in these three is puzzling.

In one (No. 66297, D. A., male), obtained at Magnetic City, North Carolina, March 26, 1894, the new fur covers the under surfaces of the animal completely, while on the upper side of the body the new fur is starting on the posterior half of the back, but is still concealed in the old fur. In the second specimen (No. 66298, D. A., male), obtained at the same locality as the first about a month later, namely, on April 24, the new fur has attained about half its full length over the whole of the lower surfaces and on the posterior half of the back, but it is still everywhere concealed by the old fur. The third specimen (No. 53823, D. A., male), obtained at the same locality as the last, about three weeks later, but in the preceding year (May 16, 1893), shows only a very small patch of new hair on the crown of the head, and there is a small amount of concealed new hair immediately around this area. There is besides a band of new hair visible on the breast: elsewhere the old hair still prevails.

As the specimens are all males, it is difficult to understand why the one taken latest shows the least advance toward a change. As regards this one, since it was taken in a different year from the other two, it may be supposed that the spring that year was less advanced than in

[1] Mammals of North America, p. 68.

1894, but this will not affect the two taken in the latter year. More specimens will be needed before the exact dates of molting can be ascertained.[1]

HISTORY OF PARASCALOPS BREWERI.

This species was first made known by Bachman in 1842,[2] under the name of *Scalops breweri*. Afterwards, in 1848, it was transferred by Pomel[3] to his genus *Scapanus* and two years ago I made it the type of a separate genus, which I named *Parascalops*.[4]

In 1879, Dr. Coues recommended the use of the name *Scapanus americanus*[5] for the species, on the ground that Harlan, in his Fauna Americana,[6] published in 1825, employed at the head of a description, which he (Dr. Coues) thought applicable to the present species, the name "*Talpa americana*," derived from a manuscript of William Barton. This view is untenable, however, because Harlan's description is wholly a translation, word for word and paragraph for paragraph, of Desmarest's description of *Talpa europæa*,[7] with only a word or a sentence here and there omitted. Even the measurements are included. It is evident, therefore, that Harlan copied nothing from Barton's manuscript, and that the latter's name is a *nomen nudum*.

In support of his position Dr. Coues cites the remark of Audubon and Bachman that "Harlan had described the skull of the species we have since described and figured as *Scalops Brewerii*, having forty-four teeth."[8] These authors were deceived, however, for Harlan's description of the skull in question is a literal translation of Desmarest's description of skull characters of the genus *Talpa*.

There were specimens of Brewer's mole in the Museum of the Zoological Society of London prior to 1829. Richardson knew of their existence, but thought that they were "true moles"—that is, representatives of the genus *Talpa*.[9] Audubon and Bachman examined them at a later date and found that they were specimens of Brewer's mole.[10]

[1] In Mr. Bangs's collection a male taken at White Sulphur Springs, West Virginia, April 29, has the new fur on all the lower surfaces except the posterior part of the abdomen, while on the rest of the body the old fur is still in place with the new concealed under it. A young male taken at the same place May 31 has all summer fur.

[2] Boston Journ. Nat. Hist., IV, 1842, p. 32.

[3] Arch. Sci. Phys. et Nat., IX, 1848, p. 247.

[4] Proc. U. S. Nat. Mus., XVII, 1894, p. 242.

[5] Amer. Nat., XIII, 1879, pp. 189–190.

[6] Page 43.

[7] Mammalogie, pt. 1, 1820, p. 160.

[8] Audubon & Bachman, Quadrupeds of North America, III, 1854, p. 219.

[9] Richardson, Fauna Bor. Amer. Mam., 1829, p. 12. These specimens are probably Nos. 163*c* and 143*d*, marked *Talpa europæa* with a query in Waterhouse's Cat. Mus. Zool. Soc. London, 1838, p. 16. They were presented by Joshua Brookes.

[10] Audubon & Bachman, Quad. North Amer., III, p. 254. See also Godman, Amer. Nat. Hist., I, 1831, p. 106, footnote.

Dimensions of skulls of Parascalops breweri.

Catalogue number.		Collection.	Locality.	Sex.	Total length.	Basilar length (Hensel).	Length of palate from inside of first incisor.	Mastoid breadth.	Greatest zygomatic breadth.	Length of superior tooth row.	Coronoid process of mandible to angle.	Age.
Skull.	Skin.											
					mm.	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	
47684	35419	Dept. Agric	Lake George, N. Y.	♀	29.9	24.6	.....	14.0	11.2	12.9	9.6	Young.
232	.....	Merriam	Leyden, N. Y	...	33.5	28.0	12.8	15.0	12.5	14.2	.....	Do.
1232	.....	.....do	Locust Grove, N. Y.	...	32.5	.....	13.0	.....	.....	13.6	10.4	Youngish.
1007	.....	.....do	.....do	♂	32.3	28.0	13.4	15.0	12.0	13.8	10.6	Adult.
1160	.....	.....do	.....do	♂	32.4	27.4	13.0	15.0	12.4	14.0	10.4	Do.
1013	.....	.....do	.....do	♀	31.8	27.0	12.8	15.0	12.3	13.7	10.4	Do.
1002	.....	.....do	.....do	♂	31.5	26.2	12.0	14.6	11.9	13.3	10.4	Do.
1769	319	Nat. Mus ...	Cleveland, Ohio.....	...	33.0	27.6	13.7	15.0	12.2	14.2	10.2	Adult, or old.
848	1670	Amer. Mus .	Ravenna, Ohio.....	♂	33.4	28.6	13.6	14.5	12.3	14.3	.....	Do.
851	1673	.....do	.....do	♂	32.9	27.5	13.4	14.6	12.3	14.0	10.4	Adult.
850	1672	.....do	.....do	♀	32.5	27.4	13.0	14.5	12.0	14.0	9.8	Adult, or less.
849	1671	.....do	.....do	♀	32.0	27.5	13.3	15.0	.....	14.0	10.0	Adult.
54091	.....	Dept. Agric	Magnetic City, N. C.	♂	33.7	28.1	13.2	15.2	12.5	14.1	10.5	Old.
54093	.....	.....do	.....do	♀	31.2	26.0	.....	14.5	12.3	13.2	9.8	Do.
50869	.....	.....do	.....do	...	32.0	27.0	13.3	15.0	11.8	13.5	10.5	Adult.
53823	.....	.....do	.....do	♂	33.0	27.6	13.5	15.0	12.3	14.0	10.0	Do.
53824	.....	.....do	.....do	♂	32.7	27.1	12.8	15.0	12.0	13.6	10.0	Do.
53826	.....	.....do	.....do	♀	31.1	26.0	12.5	14.0	11.8	13.5	9.0	Do.
57088	.....	.....do	.....do	♂	31.6	26.0	12.4	14.1	.....	13.5	.....	Do.
54087	.....	.....do	.....do	♀	31.7	26.5	12.5	14.5	12.0	13.0	9.6	Do.
54088	.....	.....do	.....do	♂	32.0	26.9	12.4	14.7	12.0	13.3	9.9	Do.
54089	.....	.....do	.....do	♀	32.0	26.2	12.5	14.7	.....	13.1	9.5	Do.
54925	.....	.....do	.....do	♂	32.0	26.5	12.4	15.0	.....	13.0	10.0	Do.

Genus CONDYLURA, Illiger.

Condylura, Illiger, Prod. Syst. Mamm., 1811, p. 125. (Type *Sorex cristatus*, Linn.)

Scalops, Fischer, Zoognosia, III, 1814, p. 156. (Type *Sorex cristatus*, L.)

Talpasorex, Schinz, Cuvier's Thierreich, IV, 1825 (?), p. 312 (fide Fischer). (Not *Talpasorex*, Lesson.)

Rhinaster, Wagler, Nat. Syst. Amphib., 1830, p. 14.

Astromycter, Gray, List Mamm. Brit. Mus., 1843, pp. xxi and 76. (*Nomen nudum*, credited to Harris, who does not use it.)

Astromydes, Blyth, Cat. Mamm. Asiat. Soc. Mus., 1863, p. 87.

Skull elongated. Interorbital constriction slight. Premaxillæ protruding. Anterior nares directed obliquely upward. Tympanic bullæ incomplete. Palate abbreviated posteriorly. Angular process of mandible linear.

Pelvis without osseous bridges behind the acetabulum. Caudal vertebræ numerous. Manubrium sterni moderate.

Dental formula i, $\frac{2}{3}$; c, $\frac{1}{1}$; pm, $\frac{4}{4}$; m, $\frac{3}{3}$; total, 44. Second upper and third lower incisors minute. Premolars tricuspidate. Molars with a broad tridentate internal basal ledge.

Nostrils anterior, surrounded by a series of large radiating tactile processes. Tail long and scaly. Fore feet broad, fossorial, furnished with an *os falciforme*. Hind feet elongate.

The genus *Condylura* is not closely allied to any other existing genus of moles, if osteological characters can be relied on. The peculiar

conformation of the skull and angle of the jaw, the form of premolar and incisor teeth, and the development of the nasal appendages are unique. Of American moles *Neürotrichus* is perhaps the nearest ally, but the gap between the two genera is considerable. In the form of the premolars we are reminded of *Talpa*, but there is no close resemblance otherwise.

In the modification of the fore limbs for fossorial purposes, *Condylura* does not reach the degree of specialization found in *Scalops* and *Talpa*. The humeri are relatively quite elongate, and the same is true of the clavicles, while the manubrium of the sternum is only moderately long. We owe the name *Condylura* to the faulty figure of the animal given by De La Faille, in which the tail is represented as constricted at intervals, the whole resembling a string of beads. From this Illiger was led to include in his diagnosis the expression "cauda mediocris nodosa," and to bestow an inappropriate name.

CONDYLURA CRISTATA (Linnæus).

STAR-NOSED MOLE.

Sorex cristatus, Linnæus, Syst. Nat., 10th ed., 1758, p. 53.
Talpa longicaudata, Erxleben, Reg. Anim., 1777, p. 118.—Shaw, Gen. Zool. I, 1800, p. 523.
Talpa canadensis, De la Faille, Naturgesch. des Maulw., 1778, p. 3, t. 1 (fide Fischer).
Talpa cristata, Kerr, Animal Kingdom, 1792, p. 201.
Talpa radiata, Shaw, Gen. Zool., Mamm., I, 1800, p. 523.
Sorex radiatus, Shaw, Gen. Zool., Mamm , I, 1800, p. 531.
Scalops cristatus, Fischer, Zoognosia, III, 1814, p. 156.
Condylura cristata, Desmarest, Journ. de Phys., LXXXIX, 1819, p. 230; Mammalogie, I, 1820, p. 157.
Condylura longicaudata, Desmarest, Mammalogie, I, 1820, p. 158.
Condylura macroura, Harlan, Fauna Americana, 1825, p. 36.
Rhinaster macrourus, Wagner, Suppl. Schreber, Säugeth., II, 1841, p. 115.
Condylura prasinata, Harris, Boston Jour. Philos. and the Arts, II, 1825, p. 582.
Rhinaster cristatus, Wagler, Nat. Syst. Amphib., 1830, p. 14.
Rhinaster longicaudatus, Wagner, Suppl. Schreber Säugeth., II, 1841, p. 116.
Astromydes cristatus, Blyth, Catal. Mamm. Asiat. Soc. Mus., 1863, p. 87. (Not seen.)[1]

Size moderate. Nasal cutaneous processes well developed, 22 in number, of which 18 are marginal and the remaining 2 pairs inserted on the nasal disk. Feet scaly. Fore feet fossorial, one-half as long as broad (including the claws). Eye comparatively large. Tail about three-fourths the length of the head and body, scaly, with scattered hairs; in winter, greatly enlarged, but with a constricted base.

Color above, dusky brown; below paler and grayer. Feet dusky. Tail indistinctly bicolored. A narrow ring of white at the wrist.

Average dimensions (6 fresh specimens, males and efmales, from Locust Grove, New York).—Total length, 202 mm.

[1] What is *Talpasorex* (*Condylura*) *fissipes?* in Minding's Geog. Vertheilung der Säugeth., 1829, p. 61?

Average dimensions (21 alcoholic specimens, males and females).—Total length, 170 mm.; tail vertebræ, 71.8 mm.; hind foot and claw, 27.1 mm.

Average dimensions of skulls.

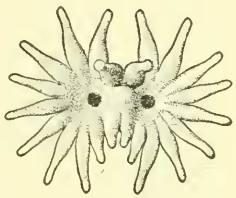
	mm.
Greatest length (9)	35.2
Basilar length (Hensel) (10)	27.6
Greatest zygomatic breadth (7)	10.2
Palate length (10)	13.5
Length of upper tooth row (base of crowns) (11)	15.2
Breadth of postorbital constriction (11)	7.1
Length of mandible, from inner base of incisors to end of angular process (11)	21.8

Type locality.—Pennsylvania.

Geographical distribution.—Rupert House and Moose Factory (Hudson Bay), Quebec, Ontario, and Manitoba on the north, southward to Minnesota on the west, to Virginia on the Atlantic Coast, and in the Alleghany Mountains to the boundary of South Carolina.

DESCRIPTION.

Form robust. Legs short. Snout broad and only moderately elongated, extended about 7 mm. beyond the anterior upper incisors in adults. Nostrils circular, opening forward on the surface of a naked disk, which is surrounded by a fringe of 22 naked lanceolate processes about 4.5 mm. long. These processes are symmetrically arranged, 11 on each side of the median line. Those forming the inner pairs above and below the nostrils are smaller than the others and have their origin on the anterior face of the disk rather than on its margin. The upper surface of the snout is naked as far backward as the point reached by the extremity of the nasal processes when laid back upon it.

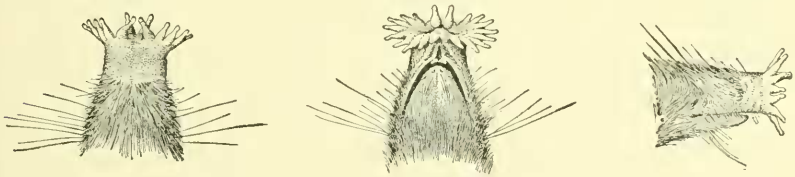


27.

NASAL DISK OF CONDYLURA.

(Twice natural size.)

Corner of the mouth anterior to the line of the eyes. Upper lip grooved in the median line below the nasal disk. Inside its margin a



28. 29. 30.

SNOUT OF CONDYLURA CRISTATA.

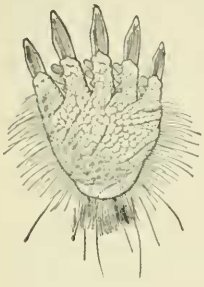
Fig. 28, Upper surface. Fig. 29, Lower surface. Fig. 30, Side view.

(Natural size.)

thin ridge extends from the median line nearly to the corner of the mouth. Lower jaw naked at the extremity.

Eyes large for a member of this family (1½ mm.), deep sunk, partially covered by the thick lids posteriorly and concealed by the dense fur. (Not visible in dry skins, but may be found by parting the fur.)

Ear-conch wanting. Auricular aperture situated above the line of fore leg; large, irregular in outline, elongate, its long axis directed obliquely downward anteriorly. It has a broad internal projection below, and a small separate *cul de sac* at the posterior end. The aperture is entirely concealed by the fur, but its position is indicated by a slight depression.

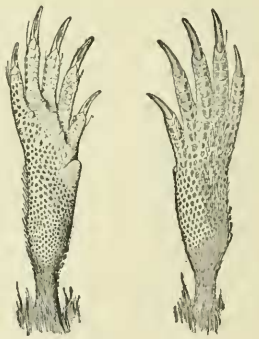


31. 32.

FORE FOOT OF CONDYLURA.

Fig. 31, Lower surface. Fig. 32, Upper surface. (Natural size.)

Fore feet large, but less so than in *Scalops*. Their breadth almost exactly one half their length (including the claw). Palms naked, covered with moderate-sized rounded scales. Outer (or upper) edge of the second, third, and fourth toes with three conspicuous flattish triangular tubercles; the first toe with two, the fifth with none. Backs of the hands covered with moderate-sized polygonal scales; those on the toes larger and somewhat symmetrically arranged.



33. 34.

HIND FOOT OF CONDYLURA.

Fig. 33, Lower surface. Fig. 34, Upper surface. (Natural size.)

First toe shortest; the second, third, and fourth progressively longer; the fifth about as long as the third. Claws depressed, broad, obliquely set; slightly concave below, except at the tip. Marked on the upper surface with inconspicuous longitudinal furrows. A single row of long, rather stiff hairs surrounds the palms, and there are two hairs only at the inner edge of the base of each claw.

35.

TAIL OF CONDYLURA. (⅔ natural size.)

The hind feet are one-fourth longer than the fore feet, narrow, scaly. Claws long, compressed. A large depressed tubercle at the base of the hallux. Toes naked (except that there are a few hairs at the base of the claws); metatarsus hairy only on the outer portion of the upper surface.

Tail in adults thick, conical, depressed (sometimes terete), with a slender base; covered with small scales in regular rows, from the distal margin of each of which three hairs project. These hairs are everywhere equally distributed, and are sufficiently numerous to partially conceal the scales.

Fur long, dense, and shining, coarser than in other American moles; consisting of two kinds of hairs, (1) a long, fine, crenulate under fur with enlarged tips, and (2) still longer, straight hairs, also with enlarged and tapering extremities, which in adults are generally more or less curved.

Color above rich, dusky brown; on the sides paler; on the under surfaces still paler and tinged with gray; young more reddish brown throughout; hairs dark plumbeous, except at the extremities; those on the face and chin in adults often nearly pure white; a ring of pure white fur around the wrist, the ankle, and the eye. Tail colored like the body, dusky above and slightly paler below, with paler or commonly white hairs on the under side at the tip or sometimes entirely white tipped. Backs of the fore and hind feet dusky. Fringe of the manus sordid white. Whiskers dusky. Claws pale.

Mammæ 4 pairs, 2 pairs inguinal and 2 pairs pectoral.

SKULL.

Facial portion long and narrow. Anterior nares directed obliquely upward. Premaxillæ extending much beyond the nasals anteriorly; the anterior half of the facial portion horizontal and the posterior half rising nearly at a right angle and meeting the nasals in their anterior fifth. Nasals terminating anteriorly in an acute point in adults, but truncate in the young; their sides parallel in the anterior half, but meeting in a very acute angle posteriorly where the nasals are inserted between the deflected borders of the frontals. Parietals irregularly triangular, emarginate on the median line anteriorly. Squamosal with a broad prolongation behind the tympanic bulla. Zygomatic arch short, straight, directed obliquely upward posteriorly. The squamosal supplies only a short portion of the posterior end of the arch, the remainder being apparently composed entirely of the zygomatic process of the maxillary. No malar can be detected even in the youngest skulls. The maxillary throws out a slender process which bridges over and confines the infraorbital foramen, and the distal end of this process is dilated and abuts against the posterior end of the lachrymals and also touches the neighboring margin of the frontal. The lachrymal is large, oval in shape, and lies on the face of the frontal. Foramen magnum large and oval, about twice as long as broad. Tympanic bullæ incomplete behind and overlaid internally by the basisphenoid. Palate short, emarginate behind, exposing the ethmoid and vomer.

Mandible with a slender horizontal ramus. Coronoid process large, erect, rather broad, and only moderately uncinate. A slight projection below the condyle on the posterior margin of the ascending ramus. Angular process long and slender as in the shrews, moderately dilated at the proximal extremity. It is slightly bent inward, and twisted upon itself so that the outer surface looks obliquely downward and the inner surface obliquely upward.

TEETH.

Dental formula: i., $\frac{3}{3}$; c., $\frac{1}{1}$; pm., $\frac{4}{4}$; m., $\frac{3}{3}$; total, 44.

First upper incisors large, half ovate, curved inward and touching each other only at the extremities. Second incisor linear, minute. Third incisor long and slender, with a small posterior basal tubercle, disappearing with age.

The canine is the smallest tooth in the row, except the second incisor. It is conical, compressed, with a small posterior basal cusp. The first, second, and third premolars similar to each other in form, but successively larger; the first with a posterior, and the second and third with both anterior and posterior basal tubercles, of which the posterior is the larger. Fourth premolar larger, with a small anterior basal tubercle, a posterior trenchant margin, and a large heel or internal basal cusp. Molars broad W-shaped in transverse section, with a broad internal basal ledge, extending entirely across the inner side of the tooth and having a tricuspidate free border. The points in which the lines meet to form the letter W, as well as the extremities, are elevated into cusps or tubercle-like thickenings, of which the inner are much the most prominent. The first molar has a small anterior basal tubercle. The third is smaller than the other two and irregularly triangular, lacking the portion corresponding to the posterior fourth of the second molar.

First lower incisor large, nearly spatulate in form, and inclined forward, so as to be horizontal. Second similar in form and position, but smaller. Third minute, with a sickle-shaped crown, and also inclined forward. Canine long, slender, and curved, with both anterior and posterior basal tubercles, of which the posterior is the larger. First premolar similar to the canine, but smaller. Second, third, and fourth premolars successively a little larger than the first and similar in form, but with a reduced central cusp and enlarged anterior and posterior basal tubercles. Between the central cusp and posterior tubercle and somewhat internal to them is placed an additional low tubercle. Molars compressed, W-shaped in transverse section, with cusps at the points representing the intersection of the lines and arms of the letter, of which cusps the external ones are much the largest and longest. The central inner one is bifurcated.

SKELETON.

In Cuvier's Leçons d'anatomie comparée the vertebral formula for *Condylura* is given as follows:

C., 7; d., 13; l., 6; s., 5; ca., 17; total, 48.

Bell[1] gives the same formula, having perhaps copied it from Cuvier. In two skeletons in the Museum collection I find the following:

C., 7; d., 13; l., 6; s., 5; ca., 19; total, 50. The last caudal is rudimentary.

[1] In Todd's Cyclopedia, Article *Insectivora*.

The intervertebral ossicles are well developed. The sternum consists of five segments, including the manubrium, which is as long as the other segments combined. It has a deep keel and short lateral processes near the anterior end for the articulation of the first pair of ribs.

The scapula is very narrow, with the infra-spinous fossa obsolete, the acromion prominent and moderately uncinate.

The humerus is one and one-half times as long as broad, and the clavicle nearly twice as long as broad, hence much less compressed than in *Scalops*.

The pelvis is contracted, but the iliac bones do not quite meet below the acetabula. There is no pubic symphysis. The sacrals dip downward behind the line of the acetabula and there is no osseous connection between them and the ischium.

The tibia is as long as the foot (including the claws) and one and two-thirds times as long as the femur. The fibula united with it above its middle point.

The terminal phalanges of the manus are bifurcated. The *os falciforme* is prominent and its distal extremity rests against a sesamoid at the outer base of the first metacarpal.

GEOGRAPHICAL DISTRIBUTION.

The range of the star-nosed mole covers an area extending on the Atlantic Coast from New Jersey to the mouth of the St. Lawrence River, and thence westward (with the northern limit at 51° N. lat.) to James Bay, Manitoba and Minnesota, and southward (in the mountains) to the boundary of South Carolina. The existence of the species in the Indian Territory and on the Pacific Coast is doubtful.

The latest monographer of the insectivora, Dr. G. E. Dobson, gives the range of the species as follows:

> North America, widely distributed, from Nova Scotia and Hudson Bay to South Carolina and northern Tennessee, extending westward through the States to Oregon and Washington Territory.[1]

I am unable as indicated above to trace the species through so wide an area, either from the specimens examined or from the records in literature. The specimens examined in the preparation of this work were from an area covering practically the whole of the New England and Middle States, with outlying localities in the Hudson Bay region, Nova Scotia, Quebec, the mountains of North Carolina, and finally Minnesota. The boundaries of the area referred to are somewhat as follows: On the south, beginning at Washington City, and Marshall Hall, Maryland, the line extends to Cleveland, Ohio; from thence along the Lakes to Ottawa, Canada; thence through Montreal to Eastport, Maine. The southeastern boundary extends from Washington to New York, thus excluding southern and eastern Maryland, Delaware, southern New Jersey, Long Island, and southern Connecticut. The outlying points

[1] Monogr. of the Insectivora, pt. 2, 1883, p. 133.

are as follows: In North Carolina, Roan Mountain; in Minnesota, Fort Ripley and Elk River; in the Hudson Bay territory, Moose Factory and Rupert House;[1] in Quebec, Godbout (about 180 miles east of the Saguenay River); in Nova Scotia, Halifax.

If a line were drawn connecting the outlying points above mentioned, it would roughly indicate the range of the species, as recorded in the literature, except in one or two directions to be mentioned presently. The range as thus indicated extends on the north to New Brunswick, James Bay, and Manitoba, on the west to Minnesota, Iowa, and Illinois, and on the south to Tennessee and North Carolina.

Audubon and Bachman sum up their knowledge of the distribution of the species as follows:

> This species is found sparingly in all the Northern and Eastern States. Dr. Richardson supposes it to exist as far north as Lake Superior. We obtained a specimen 5 miles from the Falls of Niagara, on the Canada side, and have traced it in all the New England States. We received specimens from Dr. Brewer, obtained near Boston, and from W. O. Ayres, esq., from Long Island. We caught a few of these animals near New York, and obtained others from various parts of the State. We saw a specimen at York, Pa., and found another at Frankfort, east of Philadelphia. We captured one in the valleys of the Virginia Mountains, near the Red Sulphur Springs [West Virginia], and received another from the valleys in the mountains of North Carolina, near the borders of South Carolina, and presume it may follow the valleys of the Alleghany ridge as far to the south as those latitudes. We have never found it in South Carolina or Georgia, but to the west we have traced it in Ohio and the northern parts of Tennessee.[2]

A Canadian writer, Mr. R. Bell, gives the species as common at Moose Factory, James Bay.[3] Richardson had several specimens supposed to be from Moose Factory, but he doubts that they were really from that locality. He writes on this point as follows:

> As the most southern fur posts depending upon Moose Factory are situated upon the borders of Lake Superior, it is probable that they [the "Moose Factory" specimens] came from that quarter.[4]

Whatever may be the truth as regards Richardson's specimens, the fact of the occurrence of the species at Moose Factory is established by specimen No. 15061 of the National Museum collection, which was received from Dr. Walton Hayden in 1881.

There was also in the National Museum prior to 1885 a specimen (No. 8901) received from B. R. Ross, of the Hudson Bay Company, who collected it at Rupert House in 1867.[5] There seems to be no reason to

[1] This specimen is no longer in the Museum. It was sent some years ago to Cambridge, England.

[2] Quad. of North America, II, 1851, p. 142.

[3] Canadian Geol. Survey, Montreal, 1884, 48 DD.

[4] Fauna Bor. Amer., p. 13.

[5] Rupert House is on James Bay, a little northeast of Moose Factory. The specimen, an alcoholic, was sent to the museum of Cambridge University, England, in 1885, where it is still presumably to be found. Two shrews were received with the mole.

doubt that this specimen actually came from Rupert House, which is the most northerly point at which the species has been found.

Couper records the presence of the species at Montreal, Canada, and also at the city of Quebec, where he says it is occasionally found.[1]

An anonymous writer in the Naturaliste Canadien cites it as occurring between the coast of Beaupré and the Ile d'Orleans,[2] which is in the St. Lawrence River, near Quebec.

The Department of Agriculture collection contains a specimen from much farther east, namely, at Godbout, on the north shore of the St. Lawrence, near its mouth and about 180 miles east of the Saguenay River.

In Nova Scotia and New Brunswick the species is common, according to Gilpin[3] and Chamberlain.[4]

The *Condylura prasinata* of Harris was described from a specimen from Machias, Me.,[5] and in the Sixth Report of the Board of Agriculture of Maine, it is also included among the mammals of that State.[6]

Zadock Thompson considered the species rare in Vermont. He captured two specimens in Burlington.[7]

In Massachusetts it was obtained in Essex County by Fowler,[8] and Emmons and Allen record it as common in the State, but the latter remarks that it is more numerous in the eastern part of the State than elsewhere.[9]

Linsley captured a specimen at Stratford in Connecticut,[10] but Morris regards it as not very common in that State.[11]

Dr. C. C. Abbott records the species from New Jersey, but remarks that it is not at all abundant, and that it is more frequently met with in the central than in the northern or southern sections of the State.[12]

Turning now to the West, I find that Kirtland, in 1838, had seen only one specimen in Ohio.[13] I have examined specimens from three localities in the northern part of the State—Cleveland, Garrettsville, and Ellsworth. A specimen has been sent to the Museum from the

[1] Forest and Stream, newspaper, VIII, p. 299.

[2] Nat. Canad., I, p. 146.

[3] Trans. Nova Scotia Inst., II, pt. 2, 1869, p. 59.

[4] Bull. Nat. Hist. Soc. New Brunswick, 10, 1892, p. 32.

[5] Boston Journ. Philos. and Arts, V, 1825, p. 580.

[6] Sixth Rept. Maine Board of Agric., p. 123. Dr. George P. Merrill, Curator of Geology in the U. S. National Museum, has very recently sent me a specimen from Auburn, Maine.

[7] History of Vermont, p. 28.

[8] Amer. Nat., IV, 1870, p. 761.

[9] Emmons, Quad. of Mass., 1840, p. XIX; Allen, Bull. Mus. Comp. Zool., I, No. 8, 1869, p. 222.

[10] Amer. Journ. Sci., XLIII, 1842, p. 347.

[11] Forest and Stream, newspaper, VI, 1876, p. 214.

[12] Geol. Survey of N. J., 1868, p. 752.

[13] Kirtland, List of Mammals of Ohio, 1838. Neither Langdon nor Brayton had personal knowledge of the occurrence of the star-nosed mole in Ohio.

last-mentioned locality by Mr. Ernest W. Vickers. Mr. Vickers wrote me in December, 1895, that the star-nosed mole was authoritatively known to occur in the following localities in Ohio: Cleveland and Berea, Cuyahoga County; Canton, Stark County; Cuyahoga Falls, Summit County; Suffield, Portage County; Weymouth, Medina County; Ellsworth, Mahoning County; Butler, Richland County;[1] New Philadelphia, Tuscarawas County.[2] He states that the last-mentioned locality is the most southerly point at which the species has been found in the State.

Mr. Charles Dury, secretary of the Cuvier Club of Cincinnati, in a letter dated January 4, 1896, has, however, furnished me the following information regarding the possible occurrence of *Condylura* near that city:

> There is one specimen of *Condylura cristata* in the Cuvier Club collection that was sent to us from Indiana, near the Ohio State line, a few miles north of due west from Cincinnati. This is the only specimen I have seen from the vicinity of this city. In twenty-five years' collecting in this vicinity I have never run across it myself. So it must be exceedingly rare here. I believe there are no specimens in the Natural History Society's collection.

The first specimen from Indiana, according to Evermann and Butler,[3] was obtained near Denver, Miami County. It was deposited in the museum of the Indiana Normal School and afterwards destroyed by fire. Another specimen was obtained near Deedsville, in Miami County, in 1894.

Prince Maximilian did not see anything of the species at New Harmony, on the southern boundary of Indiana, during his sojourn there in 1833. He remarks: "*Scalops canadensis* wirft überall Haufen auf, wie unser Maulwurf und ist sehr gemein, dagegen kommt hier *Condylura* nicht vor, die in Pennsylvanien gemein ist."[4]

Miles regarded the species as rare in Michigan in 1861, and had seen but one.[5] Tenney saw one at Niles, Berrien County, in 1869.[6] An anonymous writer in Forest and Stream newspaper, 1877, remarks: "Is rarely seen within the limits of the State [of Michigan], I believe, having seen but one specimen, and heard of but two more."

Messrs. Evermann and Butler, however, quote Prof. J. B. Steere as stating that the species is abundant at Ann Arbor, in low swampy ground which has been drained, and that he had taken it in Ionia County:

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[1] See Geol. Survey of Ohio, IV, p. 179, footnote.

[2] See his paper in the Third Annual Report of the Ohio State Academy of Science. His observations are also noted by Evermann and Butler in Proc. Indiana Acad. Sci., 1893, p. 134.

[3] Loc. cit.

[4] Max. zu Wied, Reise, I, p. 174.

[5] Catalogue of the Animals of Michigan, 1861.

[6] Amer. Nat., V, 1871, p. 314.

Kennicott considered the species not abundant in Illinois, but records it from Cook County.[1]

No specimens were reported to Dr. J. A. Allen from Iowa, but he regarded it as doubtless occurring in the eastern part of the State.[2]

Lapham stated in 1852 that there was a specimen from Milwaukee, Wisconsin, in the Museum of the Natural History Association at Madison,[3] and Strong states that its range includes the prairie region of the southern and central portions of the State.[4]

There is a specimen of the star-nosed mole (No. 964) from Hinckley, Minnesota, in the Museum of the Geological Survey of Minnesota.[5] according to the list of specimens published in the report of that survey.

We come now again to the outlying districts. Richardson includes the species among those which "may occur" in his Limestone Tract, but only in the southern portion. This portion of the tract is practically equivalent to Manitoba. He did not obtain any specimens from thence.[6]

Mr. Thompson writes regarding Manitoba: "Mr. Hines informs me that he has seen specimens of this mole taken within our province."[7] The exact points at which these specimens were seen is not mentioned.

So far as specimens are concerned, there is no evidence that the species is found anywhere in the United States west of the Mississippi (with one possible exception of Fort Ripley, Minnesota),[8] though, as we have seen, Dr. J. A. Allen considered its occurrence in eastern Iowa probable.

Prof. Erwin H. Barbour has written me regarding the occurrence of the species in Nebraska as follows:

> The star-nosed mole has been reported to me repeatedly. However, I have never seen one. Students have reported it so frequently that I think its occurrence in the State is reasonably sure.

I have encountered a few positive statements in the literature, which, if correct, render it necessary to extend the range of the star-nosed mole to the Pacific Coast, as Dobson has done. On theoretical grounds, I am strongly of the belief that these several records must be incorrect, though a demonstration in a matter of this kind is hardly to be made,

[1] Trans. Ill. State Agricultural Society.

[2] Proc. Boston Soc. Nat. Hist., XIII, 1870, p. 187.

[3] Trans. Wis. Agric. Soc. II, 1853. p. 338.

[4] Geology of Wisconsin, I, 1883, p. 138.

[5] Fourteenth Report Geol. Survey Minn., 1886, p. 142. See also Ames in Bull. Minn. Acad., 1874, p. 69.

[6] Fauna Bor. Amer., p. xxvii.

[7] Thompson, Mammals of Manitoba, p. 21.

[8] Fort Ripley, Minnesota, is on the east side of the river in some maps and on the west side in others. The land office map of 1892 indicates a town of this name on the east side and a fort on the west side. The single specimen in the collection probably came from the vicinity of the fort, and hence from the west side of the river.

as the fact that no specimens are now known does not preclude their being obtained hereafter.

It would seem improbable that anyone who had examined one of these moles could mistake its identity, considering the very peculiar character of the nasal appendage. If mistakes have occurred, it must have been through faulty field notes or lapses of memory.

One of the records referred to is that of Woodhouse. In the zoology of Sitgreave's Zuni and Colorado River Expedition, he remarks of the species: "This animal is very common in the Indian Territory."[1]

He does not support this positive statement by mention of any localities, and there were no specimens of the mole sent to the Smithsonian Institution with the mammals of the expedition. As no specimens have been taken within 500 miles of the Territory, the record would seem to need confirmation.

The records relating to the Pacific Coast are equally positive. Richardson, in an addendum to the report on the mammals of the Fauna Boreali Americana, introduces *Condylura macroura* Harlan (=*C. cristata*) with the following remark:

> Since the greater part of the preceding sheets were printed off, Mr. David Douglas has presented me with a specimen of this remarkable animal, procured by him on the banks of the Columbia.[2]

There can be no doubt that this specimen was a *Condylura*, and if there is an error in this case it must be in the record of the locality. Douglas was on the Pacific Coast for three years, and had ample opportunities to obtain rarities, but he also crossed the continent going and returning, and may have picked up this specimen in southern Canada or in the vicinity of Hudson Bay. This is, however, entirely an assumption.

Another record occurs in Cooper and Suckley's Natural History of Washington Territory, as follows:

> In 1852 I saw a very large star-nosed mole which had been killed at Orleans Bar on Klamath River.—G[ibbs].
>
> Dr. Cooper saw at Vancouver, W. T., in 1853, a decayed specimen which had the appearance of having a radiated excrescence on the nose, but, being crushed and nearly destroyed, the specimen was unfit for preservation.[3]

In this second instance, Dr. Cooper may of course have been mistaken regarding the identity of his specimen, as it was in such bad condition, but Gibbs's statement is quite as positive as Richardson's. It is to be regretted that Gibbs did not specify where he saw the specimen he mentions.

The doubt which I throw on these Pacific Coast records is based (1) on the fact that if accepted it is necessary to suppose that an area of 1,200 or 1,400 miles in diameter in the middle of the range is uninhabited; (2) that no specimens from the Pacific Coast are to be found in

[1] Sitgreave's Zuni and Colorado R. Exp., p. 43.

[2] Fauna Bor. Amer., Mammalia, p. 284.

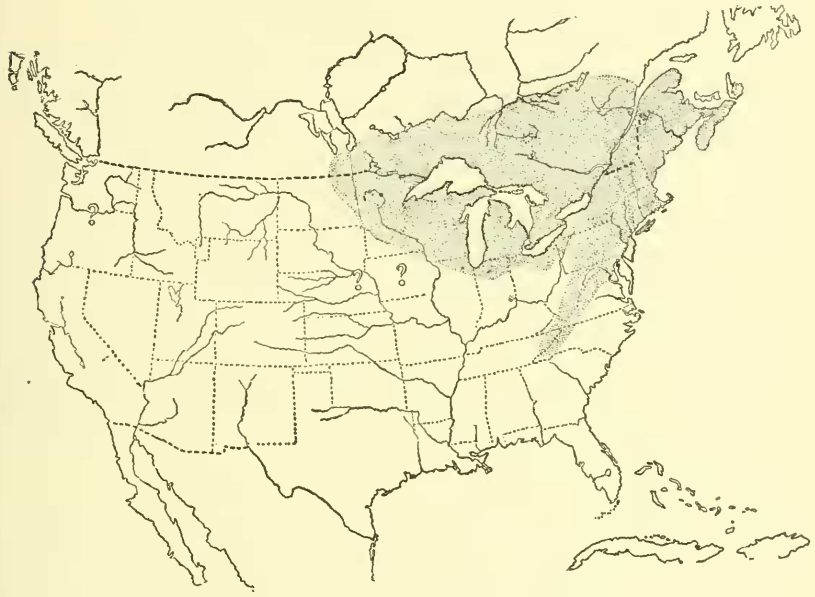
[3] Cooper and Suckley, Natural History of Wash. Ter., 1860, chapter 3 (by Suckley & Gibbs), p. 108.

any collection; (3) that no naturalists familiar with the region, with whom I have communicated, have ever seen or know of specimens taken there.

Mr. Walter E. Bryant wrote, under date of February 11, 1895: "I have never heard of the occurrence of *Condylura cristata* in California nor on the Pacific Coast."

VARIATION.

This species does not appear to present a large amount of variation, either geographical or individual. As the material at command is not extensive, however, it is possible that more variation exists than can now be shown.



GEOGRAPHICAL DISTRIBUTION OF CONDYLURA.

The coloration is, on the whole, remarkably uniform, and the size does not appear to vary in accordance with the geographical location of the specimens. One of the adult specimens from Locust Grove, New York, is much more reddish on the under surfaces than others from the same locality. This is especially true about the base of the tail. A skin from Erie, Pennsylvania, has much fewer coarse hairs on the belly than other specimens. These are quite widely separated and are light colored and shining, so that they give to the under surface a somewhat peculiar appearance. In many of the specimens a few of the longer hairs of the upper surface are white. In a young specimen from Fort Ripley, Minnesota (No. 567, N. M.), and an adult from Halifax, Nova Scotia (No. 3908, N. M.), the tip of the tail is white. This appears, however, to be merely an individual variation. In the former specimen also, that from Fort Ripley, the last lower premolar on the left side

has two equally high and prominent central cusps, instead of one. The tooth on the right side of the mandible is normal.

In several specimens the minute second upper incisor, or the third lower one, is absent on one or both sides, but unless the skull is in the best condition for study, it is extremely difficult to determine whether these teeth have merely fallen out, or whether they were absent from the first.

MOLTING.

The series of skins of the star-nosed mole obtained by Mr. Bangs at Belmont, Massachusetts, between October 6 and October 8, show that molting was then in progress. A male taken October 8 has the summer fur still in place all over the body, but new fur is concealed on all the upper surfaces. In another male taken at the same date the new fur has appeared on the head and rump and also on the throat, and is springing up all over the back, though still concealed. On the lower surfaces, except the throat, the summer fur still holds place. In still another specimen taken at the same date the condition of the new fur on the back is the same as in the last specimen, while on the lower surfaces the new fur has appeared everywhere except on the throat and legs. Two males taken October 6 and October 7, respectively, are about in the condition of the second specimen mentioned above.

The change is carried to its completion in Mr. Bangs's series from Digby, Nova Scotia. In specimens taken from October 10 to October 21 the upper surfaces are all covered by new fur, while the lower surfaces all have the summer fur, with the new concealed under it. In males taken October 27 and October 30 the change is complete and all summer fur has disappeared.

From these specimens we learn that the winter fur of this mole first appears on the surface about October 6, (in the North), completing its growth first on the head and rump, then on the back, and finally on the belly. Exactly when the new fur first begins to sprout is uncertain, but must be earlier than September 19, as a specimen taken at Cape Edward on that date has new fur concealed under the old. The rate of growth on the different parts of the body is not always the same.

As regards the change from winter to summer fur, it appears from Mr. Bangs's series that in Nova Scotia the males have completed it before July 18. The females, as in other species, retain the winter fur longer. One taken at Digby July 25 still has irregular patches of winter fur across the back. A female taken July 31 has the complete summer coat.

AGE CHARACTERS.

Young star-nosed moles are much redder than adults. The fur about the mouth and on the feet is also of a reddish-brown color, while in adults it is usually whitish. The tail is also slender in the young.

Besides the ordinary obliteration of sutures, a sign of maturity in

skulls of this species is the growth of median crests on the anterior portion of the sagittal suture, and on the posterior extremity of the nasals. This nasal crest is, so far as I am aware, unique among mammals.

The teeth are but little worn in any of the specimens which I have examined, which would seem to indicate that they have a thicker coat of enamel than those of *Scalops*, *Scapanus*, and *Parascalops*. In these the teeth show the effects of attrition at a comparatively early stage.[1]

THE TAIL AND NASAL DISK.

It is a well-known fact that the tail of the star-nosed mole is subject to a periodical enlargement. An individual in this condition was described by Harlan in 1825 as a distinct species, but Godman recognized the fact (in a publication of the same date[2]) that this character was not specific. He stated that all the specimens with enlarged tails which had been examined were males, and remarked: "It is most probable that the enlargement occurs only during the rutting season."

It now appears that Godman's opinion that the enlargement occurs only in males is not correct. Of ten completely labeled specimens with swollen tails which I have examined, five are males and five females. The swollen condition lasts at least from November to April, inclusive, and probably a month longer in spring. The tail is not enlarged in any of the specimens taken in the summer months.

It is probably correct to look upon this enlargement of the tail as a secondary sexual character, comparable to the growth of antlers in deer. It affects both sexes, however, which is the exception rather than the rule among deer. The enlargement occurs during the rutting season, as Dr. Merriam has remarked,[3] but the first litter is doubtless born while the tail of the adults is in the enlarged condition. Though the fact seems not to have been recorded, I judge from the examination of an immature individual that this first litter appears very early in spring. This being the case, there would still be time for the production of a second litter while the tails of adults were enlarged, but if more are produced, as Dr. Merriam states to be the fact, the later ones would be brought forth after the enlarged condition had disappeared. There are no observations, so far as I am aware, bearing directly on this point.

[1] A female from Williamstown, Massachusetts (No. 7469), contains 5 embryos about 12 mm. long, three on the right side of the uterus and two on the left. The fetus is rolled together in a compact form. The forefeet are pressed against the sides of the muzzle with the palms outward. The hind feet have the soles pressed together and the tail is curled over them. The cutaneous processes of the nose are reflexed over the muzzle.

[2] Journ. Phila. Acad., V, pt. 1, 1825, pp. 109–116.

[3] Trans. Linn. Soc. N. Y., II, p. 54.

The specimens at command have the tail as follows:

Cat. number.	Sex.	Date.	Condition of tail.	Preservation.
No. 4377, Merr		May 20	Slender	Alcoholic.
No. 2241, U. S. N. M		June or July.	do	Do.
No. 11143, U. S. N. M		July —	do	Skin.
No. 11245, U. S. N. M		July 1	do	Alcoholic.
No. 669, Merr		July 2	do	Do.
Unnumbered, U. S. N. M.		July 24	do	Do.
Unnumbered, Merr		Aug. 2	do	Do.
No. 1637, Merr	(Young)	Oct. 8	do	Skin.
No. 515, Merr	Male	Nov. 12	Swollen	Do.
No. 668, Merr	do	do	do	Alcoholic.
No. 516, Merr	Female	Nov. 24	do	Skin.
No. 517, Merr	Female	Nov. 25	do	Do.
No. 520, Merr	Male	Nov. 26	do	Do.
No. 518, Merr	Male	do	do	Do.
No. 519, Merr	Female	do	do	Do.
No. 1083, U. S. N. M	Male	Dec. 15	do	Do.
No. 52723, D. A	Female	Mar. 3	Moderately swollen	Do.
No. 52724, D. A	Male	Mar. 31	Less swollen	Do.
No. 52725, D. A	Female	Apr. 11	Moderately swollen	Do.
No. 15225, U. S. N. M		May 15	Swollen	Alcoholic.

Although it is not the intention in this work to describe the anatomy of the various forms, in which direction much has been done by the late Dr. Dobson[1] and others, it seems desirable to include an account of the nasal disk of *Condylura* which was published about ten years ago by Mr. H. Ayres. As Mr. Ayres's description of the anatomy of this remarkable organ is brief, and is included in a publication not everywhere accessible, I have thought it desirable to quote it entire:

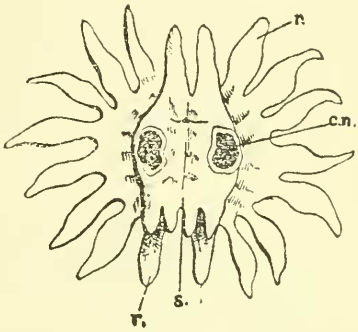
> The structure and development of the rays encircling the end of the snout in *Condylura* have not, so far as I am informed, been described. However, in the related genus *Talpa*, Eimer[2] has studied the structure of the snout of the common European mole, and considers it to be a highly developed tactile organ, on account of the characteristic nerve endings found in the numerous and rounded papillæ covering the surface of the end of the nose. This flexible snout is sharply marked off from the rest of the nose by the entire lack of hair and hair follicles.
>
> In *Condylura* the snout is much longer than in *Talpa*, and carries at its distal end a varying number of finger-shaped processes, which bound a cup-shaped or flat terminal disk (fig. 36), perforated on either side of its center by the oval nostrils (c. n.).
>
> Instead of a general distribution of the tactile papillæ over the surface of the snout itself, such as occurs in *Talpa*, one finds them confined, for the most part, to the flexible, finger-shaped processes (fig. 36). The papillæ, which are clearly visible to the unaided eye, appear, under a low magnifying power, as uniformly rounded prominences disposed in more or less regular rows, extending in the direction of the long axis of the ray.
>
> It is evident from the anatomical relationship of the two animals that *Condylura* is only a highly modified form of *Talpa*.[3] The lengthened tail, the elongated snout with its remarkable tactile organs, together with the extended skull and the increased number of teeth, are conditions indicating greater specialization; but still easily derivable from the more primitive talpine form. It is quite apparent that the increase in the extent of the tactile surface and its more definite localization in the case of *Condylura* are only expressions of the existence of a higher functional activity than is possessed by the homologous tract in *Talpa*.

[1] Monograph of the Insectivora.

[2] Arch. für mikr. Anatomie, VII, 1871, pp. 181–191, pl. 17.

[3] To this view of the affinity of the two genera I can not subscribe. F. W. T.

It would be interesting to know more of the habits of *Condylura* in order to learn in what respects they differ from those of *Talpa*, and by this means to ascertain the immediate causes of this remarkable sensorial adaptation. Since *Talpa* may be considered the more primitive form of the two, it becomes a matter of considerable interest to trace the development of these finger-shaped processes in *Condylura*. One would naturally expect that in their first stages of development they would simply resemble the rounded elevations of the papillated tactile surface of the snout of such a form as *Talpa europæa;* the parts of the snout most frequently brought in contact with foreign bodies ultimately developing the papillæ to a far greater extent than the remaining portions of the surface.



36.

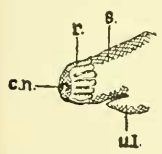
NASAL DISK OF CONDYLURA.

(Enlarged.)

By a gradual elongation of such elevations, to be accounted for on the principle of adaptation to environment, they would acquire the finger-like form present in *Condylura*. Their arrangement on the edge of a subreniform disk receives its explanation in the fact that the nerve endings are in this manner placed in a position most advantageous for the exercise of their special function.

When we trace the development of the snout in *Condylura*, we find that the assumed method of growth is very nearly an expression of what actually takes place. In the course of the development there arises an interesting complication of the simpler process, the evident meaning of which is the shortening, in point of time, of the growth of the papillæ—i. e., it is an economic adaptation. This modification I shall now describe.

At birth the star-nosed mole is nearly destitute of visible hair, and the tactile bristles of the facial region have not made their appearance at the surface. The snout of the young *Condylura* lacks all the distinctive characteristics of the adult, and the entire body resembles that of *Talpa* much more than it does its parent. On a close examination of the distal end of the snout of such a new-born animal (fig. 37), one can distinguish a tract of skin which covers four-fifths of the circumference of the organ (the part not specially marked off is the median ventral fifth). This dermal tract extends for 3 mm. toward the base of the snout and is marked off from the remaining surface by a series of furrows running parallel to the long axis of the body. A series of parallel ridges is thus formed, each ridge being bounded on either side by a furrow. At their anterior and posterior ends these ridges pass gradually into the neighboring smooth surface. By a gradual ingrowth of the bottoms of the furrows each groove is deepened and each ridge suffers a correspondingly increased definition of form, while at the same time the posterior end of each groove grows toward its neighbor on either side. When the grooves have all united, there is formed by their union a common groove which nearly encircles the snout and separates the tactile from the remaining surface of that organ.



37.

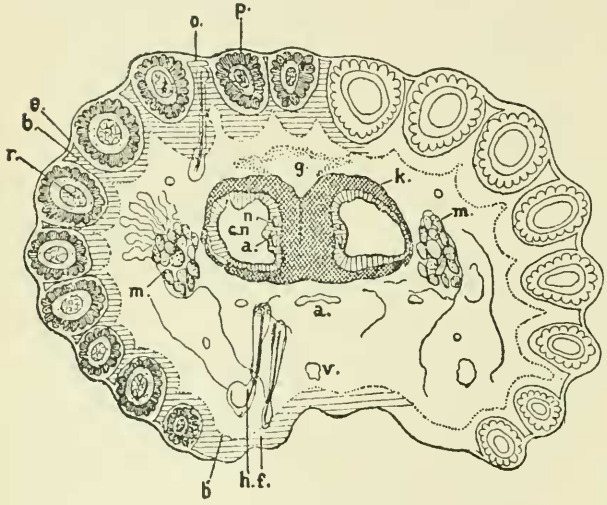
SNOUT OF YOUNG CONDYLURA.

Commencing at the posterior margin of the tactile surface and advancing toward the tip of the snout, the grooves deepen and grow toward each other in their bottom portions until they finally coalesce underneath the ridges. The result of this process is the production of free, finger-shaped processes composed exclusively of ectoderm, attached to the anterior end of the snout in the manner already described for the adult.

These processes of the ectoderm become the tactile rays of the adult. The nasal area from which the tentacular processes are formed is not thereby denuded of

skin, but remains covered by that portion of the primary surface which formed the bottoms of the grooves and which has so increased in extent that at this stage the surface is entirely and uniformly covered by ectoderm. No traces are left either on the surface or in the corium of the extensive excision which has taken place.

The principal details of the process are readily seen on examining a section of the snout, such as is represented in fig. 38. In this figure I have drawn, with the aid of camera outlines and with diagrammatic shading, a transverse section of that part of the nose of a young *Condylura* indicated by the line *r*, fig. 37. The following is a short account of the most important histological details of the process. The entire circumference of the section is bounded by a thin layer of epidermal cells *e*, beneath which all the formative processes take place. In the stage of development represented in fig. 38, this layer only loosely covers the snout in the region of the papillæ and later is entirely cast off: but it remains in intimate connection with the remaining surface and functions as the true epidermal layer, as at *f*. The letters *o p* designate respectively the epidermis of the tentaculiferous area and that of the sense rays. The rays are embedded in a layer of fibrous tissue, which, however, does not entirely cover the outer surface of the ray.



38.

TRANSVERSE SECTION OF SNOUT OF YOUNG CONDYLURA.

(Enlarged.)

a = arteries; *b* = ridge-like remnants of the primitive ectoderm seen in section; *b* = boundary line between Rete Malpighii and corium; *cn* = nostrils; *e* = cornified layer of the epidermis; *g* = cartilaginous tissue; *h* = hair follicle and accessory gland; *k* = nasal cartilage; *m* = nasal muscles; *n* = nerve supplying the mucous membrane of the nose; *o* = the future outer surface of the snout; *p* = papillæ; *r* = tactile ray, the line points to the central connective tissue *con*, through which the blood vessels and nerves pass; *v* = vein.

Sections of the ray present a crenate margin owing to their passage through the numerous tactile papillæ which cover the surface of the ray; there are three sharply marked concentric layers of tissue to be observed in each: An outer, cornified layer of the epidermis, the deeper Malpighian layer, and a central rod of connective tissue within which the nerves and blood vessels are embedded.

There are no traces of hair follicles, sebaceous or sweat glands to be seen on the tentacles, but they occur in the proximal half of the tentaculiferous area, and only make their appearance on the surface of the snout after the tentacles have assumed their erect condition. At *i* and *h* are seen the hair follicles with the young hairs. The corium is an extensive layer filling all the space between the epidermis and the nasal cartilage. The small muscles of this part of the face appear to be entirely embedded within this layer.[1]

[1] On the Structure and Development of the Nasal Rays in *Condylura cristata*. By H. Ayres. Biolog. Centralblatt, IV, 1885, pp. 356–360.

HISTORY.

We encounter this species for the first time under the name of *Sorex cristatus* in the tenth edition of Linnæus's Systema Naturæ (1758, p. 53). He gives Pennsylvania as its habitat, on the authority of Kalm. The description is recognizable, though in some respects faulty, as, for example, in relation to the number of processes of the nasal crest and the length of the tail. Houttuyn, in 1761,[1] merely paraphrases Linnæus's description and adds nothing. The description of the twelfth edition of the Systema Naturæ[2] is essentially the same as that of the tenth edition. The next author who mentions the star-nosed mole appears to have been Pennant, who published the first edition of his Synopsis of Quadrupeds in 1771. I have not had access to this work, which contained both a description and a figure.[3] I suppose that the figure was the same as that which appears in the third edition of his work, published in 1783. This latter figure, though crude, is recognizable, but the tail is too short, an error which seems to have been perpetuated for a long time.

Pennant appears to have originated in his first edition the erroneous statement that the star-nosed mole subsists upon roots. He had, however, the merit of placing the species among the moles rather than with the shrews.

In the first edition he included also a description and figure[4] of a "long-tailed mole." If this description is the same as that of the third edition, the phrase "mole with a radiated nose" must have been overlooked by Erxleben, who records the species in 1777 under the name of *Talpa longicaudata*, and seems to have had no suspicion that it was related to the star-nosed mole.[5] He records also the latter, uniting the descriptions of the authors who preceded him, including both errors and facts. He retains the species in the genus *Sorex*, but states that "*Sorex cristatus* and *aquaticus* agree with the mole in the form of the body and its habit, but, so far as the teeth are concerned, have the structure of the shrews."[6]

Schreber, in 1778, copies Linnæus and Pennant.[7]

Pennant's figure of the star-nosed mole, in the third edition of his Quadrupeds, 1783, has already been referred to. It was apparently made from a specimen in the Leverian Museum.[8] His figure of the

[1]Nat. Hist. of Dieren, I deel, 2 stuk, 1761, p. 315.

[2]Linn. Syst. Nat., 12th ed., 1766, p. 73.

[3]Cf. Linn. Syst. Nat., 13th ed., 1788, p. 112.

[4]P. 314, No. 244, pl. 28, fig. 2. (Fide Gmelin.)

[5]Syst. Regn. Animal., 1777, p. 118. Müller in 1773 (Des Linné Natursystem, I, 1773, p. 300) mentions *C. cristata* under the name of "Die Haarnase, *Sorex cristata*," but gives no new information regarding it. He does not mention the "long-tailed mole."

[6]Loc. cit., p. 121, footnote.

[7]Saügethiere, 3 Th., 1778 (?), p. 561.—"Der langschwanzte Maulwurf. P. 566, "Der Kammnase."

[8]History of Quadrupeds, 3d ed., II, 1783, p. 232, pl. 90, fig. 1, No. 442.

"long-tailed mole" also appears in this edition.[1] It shows little more than a trace of the nasal crest, and were it not for the phrase "mole with a radiated nose" in the description, one might suppose that it had no relation to *C. cristata*, as Erxleben seems to have done. It is to be remarked regarding both these figures that the tail is abnormally short. One can only suppose that they were based on young specimens, overstretched as regards the body, or that the tail was drawn in in skinning, and not afterwards restored to its proper position.

Gmelin, in the thirteenth edition of Linnæus's Systema Naturæ, recognizes both "*Sorex cristatus*" and "*Talpa longicaudata*."[2] His descriptions do not differ materially from those of Erxleben.

Kerr, writing in 1792,[3] seems to have entertained the idea that the two species were related, as he places *longicaudata* immediately after *cristata* in the genus *Talpa*. He adds nothing, however, to Pennant's account.

Shaw retains the two nominal species among the moles in his General Zoology,[4] but remarks under the "Radiated Mole:" "It is, perhaps, in reality no other than a variety of the former species, or a sexual difference."

The star-nosed mole was placed in its present genus, *Condylura*, by Illiger, in 1811.[5] As species he has "*Sorex cristata* Linn., *Talpa longicaudata* Linn. Gmel."

Cuvier recognizes only the species *cristatus* in the Regne Animal, but places it under the genus *Talpa*, and remarks that it is a true mole and that the characters on which Illiger based the genus *Condylura* are false.[6]

This course was not acceptable to Desmarest, who revived the genus *Condylura* and recognized the same species as Illiger, *C. cristata* and *longicaudata*.[7] Dr. Harlan, in 1825, accepted this arrangement and added a third species, *C. macroura*, from a specimen in the Philadelphia Museum (No. 836), which had the tail in the swollen state. Dr. Harris described another specimen in this condition the same year, under the name of *Condylura prasinata*.

Godman was of the opinion that this swelling of the tail was not a specific character, and in his Natural History, of which the first edition appeared in 1826, recognized only *C. cristata*.

All four species were enumerated by Wagner again in 1841, in Schreber's Saügethiere, but in an appendix he calls attention to Godman's view.

In the great work of Audubon and Bachman only the single Linnæan

[1] History of Quadrupeds, 3d ed., II, 1783, p. 232, pl. 90, fig. 2.
[2] I, 1788, pp. 118 and 121.
[3] The Animal Kingdom of Linnæus, 1792, p. 202.
[4] I, pt. 2, 1800, p. 523.
[5] Prodromus systematis mammalium et avium, 1811, p. 125.
[6] Regnè Animal, 1st ed., I, 1817, p. 138.
[7] Mammalogie, I, 1820, pp. 157–158.

species is recognized, and there has been practically no difference of opinion on the subject of species since the publication of that treatise, though all the names appear in the uncritical compilation of Fitzinger in 1869.

The generic name *Condylura* was replaced by *Rhinaster* by Wagler in 1830, because he considered the former appellation misleading. "Wie bekannt," he remarks, "ist der Schwanz dieses Thieres vollkommen eben."[1] Gray employed the name *Astromycter* for the genus, in 1843, in his List of Mammals in the British Museum, but credits it to Harris, who did not use it. A new name—*Astromydes*—was coined by Blyth in 1863.

MEASUREMENTS.

Collector's measurements of six specimens, both males and females, from Locust Grove, New York, in Dr. Merriam's collection, give an average of 202 mm. for the total length (including the tail), with a maximum of 212 mm. and minimum of 200 mm.

This average, it will be observed, is higher than that given by the alcoholic specimens.

Dimensions of alcoholic specimens of Condylura cristata.

Measurements.	Males.				Females.			
	Average.	Maximum.	Minimum.	No. of specimens.	Average.	Maximum.	Minimum.	No. of specimens.
	mm.	*mm.*	*mm.*		*mm.*	*mm.*	*mm.*	
Length of head and body	97.4	101.5	92.4	10	99.3	110.5	88.2	11
Length of tail vertebræ	69.6	80.3	55.7	10	73.9	82.0	59.8	11
Length of tail with hairs	73.9	85.9	61.6	10	80.5	91.0	67.4	11
Length from nose to eye	15.8	17.8	14.2	9	15.3	16.3	13.8	9
Length of fore foot and claw	20.4	21.5	19.0	10	20.8	23.0	19.0	11
Greatest breadth of fore foot	10.6	11.5	9.4	10	11.1	12.4	9.6	11
Length of hind foot and claw	26.7	29.3	24.9	10	27.4	29.4	25.2	11
Length of longest hair of back	10.7	.....	.....	.....	10.9	.....	.....	.....

Average, maximum, and minimum dimensions of adult skulls of Condylura cristata.[2]

	Average.	Maximum.	Minimum.	Number of skulls.
	mm.	*mm.*	*mm.*	
Greatest length (exclusive of incisors)	34.0	34.8	32.5	7
Basilar length (Hensel)	27.7	28.4	26.6	7
Greatest breadth	13.7	14.3	13.0	7
Length of foramen magnum	6.6	7.0	6.4	7
Breadth of foramen magnum (at middle of its length)	3.4	3.8	3.2	7
Palate length	13.7	14.2	13.0	7
Length of upper tooth row (base of crowns)	15.2	15.7	14.0	7
Least interorbital breadth (back of frontals)	7.1	7.4	6.4	7
Length of mandible, from inner base of incisors to end of angular process	22.0	22.4	21.0	7
End of angular process to end of coronoid	8.5	9.0	8.0	7

[1] Natur. Syst. Amphib., 1830, p. 14.

[2] As there appears to be no difference in proportions between male and female skulls, both are included in the averages.

Dimensions of thirty-one skulls of Condylura cristata from various localities.

Catalogue number.		Collection.	Locality.	Sex.	Total length.	Basilar length (Hensel).	Length of palate from inside first incisor.	Mastoid breadth.	Greatest zygomatic breadth.	Length of upper tooth row.	Breadth between postero-internal angles of first upper molars.	Angle of mandible to condyle.	Age.
Skull.	Skin.												
					mm.	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	*mm.*	
3908	.....	Bangs	Lake Edward, Quebec.	♀	34.0	26.9	13.5	13.3	.....	15.0	7.5	6.6	Adult.
1210	.....	.....do	Digby, Nova Scotia.	♂	35.0	28.5	14.5	13.7	10.6	15.8	7.7	7.0	Do.
1211	.....	.....do	.....do.....	♂	34.8	27.4	14.3	13.7	.....	15.2	8.2	6.7	Do.
1212	.....	.....do	.....do.....	♂	34.0	27.3	14.0	13.2	10.2	15.2	7.8	6.4	Do.
1214	.....	.....do	.....do.....	♂	33.4	26.5	13.4	13.5	10.1	15.0	7.3	6.2	Do.
1215	.....	.....do	.....do.....	♂	34.4	27.2	14.0	13.3	.....	15.0	7.6	6.5	Do.
2093	.....	.....do	.....do.....	♂	35.2	27.8	14.2	14.0	....	15.5	8.0	6.8	Do.
2096	.....	.....do	.....do.....	♂	35.0	27.8	14.5	13.5	10.2	15.5	7.8	6.8	Do.
2097	.....	.....do	.....do.....	♂	35.0	28.2	14.2	13.4	10.5	15.6	7.0	6.9	Do.
2099	.....	.....do	.....do.....	♂	33.5	27.0	13.6	13.5	...	15.0	7.0	6.5	Do.
2100	.....	.....do	.....do.....	♂	34.0	27.0	13.6	13.2	10.2	15.0	7.5	6.5	Do.
2095	.....	.....do	.....do.....	♀	35.0	27.2	14.0	14.0	10.0	15.0	8.0	6.5	Do.
2101	.....	.....do	.....do.....	♀	34.2	27.0	14.0	13.4	.....	15.0	8.0	6.5	Do.
1213	.....	.....do	.....do.....	♀	33.8	26.6	13.2	13.0	.....	14.9	7.5	6.7	Do.
4336	.....	.....do	Belmont, Mass ..	♂	35.2	28.2	14.0	13.5	.....	15.2	8.0	7.0	Do.
4337	.....	.....do	.....do.....	♂	35.0	28 0	14.0	13.0	.....	15.0	7.6	6.8	Do.
4338	.....	.....do	.....do.....	♂	35.5	27.8	13.5	13.8	10.2	15.0	8.0	7.0	Do.
4339	.....	.....do	.....do.....	♂	36.0	29.0	14.4	13.6	10.0	16.0	7.5	7.0	Do.
3115	2243	Nat. Mus ...	Middleboro, Mass.	...	35.4	27.5	13.5	14.4	.....	15.2	8.0	6.6	Do.
64346	.....	Dept. Agric.	East Hartford, Conn.	♂	33.6	.....	.....	13.2	.....	.....	.....	.....	Do.
1690	568	Nat. Mus ...	St. Lawrence County, N. Y.	...	.....	.....	.....	.....	.....	15.0	.....	.....	Adult or less.
1012	.....	Merriam	Locust Grove, N. Y.	♀	36.0	28.3	13.8	13.7	10.4	16.1	7.8	6.9	Adult.
1010	.....	.....do	.....do.....	♂	36.0	28.3	13.8	13.9	10.0	15.3	7.6	6.5	Do.
1011	.....	.....do	.....do.....	♂	35.3	28.4	13.7	14.0	10.4	15.7	7.8	7.1	Do.
5162	.....	.....do	(?) ..do.....	...	35.0	27.6	13.6	13.2	10.2	15.0	7.2	6.8	Do.
1008	.....	.....do	.....do.....	♂	34.9	27.6	13.4	13.8	10.5	16.0	7.4	6.8	Do.
1009	.....	.....do	.....do.....	♀	33.6	26.8	13.2	13.9	10.4	15.1	7.8	6.7	Do.
4857	.....	Nat. Mus ...	Chester County, Pa.	...	34.4	27.3	13.6	13.2	.....	15.0	7.2	6.2	Do.
582	.....	.....do	Carlisle, Pa.....	...	33.6	.....	13.7	13.2	.....	.....	.....	.....	Do.
52723	.....	Dept. Agric.	Garrettsville, Ohio.	♀	31.7	.....	13.2	13.3	.....	.....	.....	.....	Do.
52724	.....	.....do	.....do.....	♂	32.7	.....	13.2	13.4	.....	.....	.....	.....	Do.

NEÜROTRICHUS, Günther.

Neürotrichus, GÜNTHER, Proc. Zool. Soc. London, 1880, p. 441.

Body talpiform. Tail elongate. Snout long. Nostrils in the sides of the terminal naked pad of the snout. Eyes minute. Fore feet broad, but without *os falciforme*; furnished with long, rather sharp, and somewhat compressed claws.

Dental formula i, $\frac{3}{3}$; c, $\frac{1}{1}$; pm, $\frac{2}{2}$; m, $\frac{3}{3}$; total, 36.

Anterior upper incisors broad. Internal basal cusp of second upper molar bilobed. Tympanic bullæ incomplete.

This genus is very closely allied to the *Urotrichus* of Japan, and a diagnosis framed to contrast it with that form could contain only characters based on the dentition. All the other characters given above are common to the two genera.[1]

[1]The differences in the number and size of the scales and tubercles of the feet, represented in Dr. Günther's figures, are illusive. These parts are practically identical in both forms.

The differences in dentition are much more than mere absence of one tooth above in *Neürotrichus* and one below in *Urotrichus*. The Japanese mole has the first upper incisor long, slender, and curved, with an external accessory cusp, while in *Neürotrichus* this tooth is broad and flat. The second tooth in *Urotrichus* is like the first, but only about half the size, while the third and fourth are minute and simple. In *Neürotrichus* the second and third teeth are about equal in size (much smaller than the first) and compressed, while the fourth is much larger, thick and conical. Leaving out of consideration the fifth tooth in *Urotrichus*, the sixth is single-rooted, while in *Neürotrichus* the corresponding tooth (fifth) is double-rooted.

In the mandibular teeth the differences are fully as striking. The first four teeth in *Neürotrichus* have rounded oblique crowns, and are graduated in size from in front backward. In *Urotrichus* the first and second teeth are somewhat like the upper ones, long and crooked, the second much smaller than the first, with a linear and very oblique crown; then follows a tooth of medium size with oblique, somewhat spatulate crown, and another very small one.

The milk dentition of *Neürotrichus* in some particulars resembles that of the Japanese mole more than the permanent dentition, but I have not been able to examine a specimen of the American mole with complete milk dentition.

The Japanese mole is much larger than *Neürotrichus*.

NEÜROTRICHUS GIBBSII (Baird).

GIBBS' MOLE.

Urotrichus gibbsii, BAIRD, Rept. Pacific R. R. Survey, VIII, 1857, p. 76, pl. XXVIII; Mammals of North America, 1859, p. 76, pl. XXVIII.

Neürotrichus gibbsii, GÜNTHER, Proc. Zool. Soc. London, 1880, p. 141, pl. XLII.

Diagnosis.—Tail two-thirds the length of the head and body, scaly and sparsely clothed with long black hairs. Feet scaly and sparsely clothed like the tail. Fore foot two-thirds as long as hind foot,[1] and a little more than half as broad as long. Fore claws longer than the toes. Eye minute. Auricular orifice large.

Color uniform deep dusky brown, with hoary reflections and purple iridescence.

Upper canine two-rooted. Second and third upper incisors small, subequal. Crowns of lower incisors and canine oblique. Mandibular angle slender and curved.

Average dimensions of 33 specimens from Sumas, British Columbia.—Total length, 113.6 mm.; tail, 37.1 mm.; hind foot, 16.6 mm.

Average dimensions of 12 skulls from Sumas, British Columbia.—Total length, 22.8 mm.; basilar length (Hensel), 18.3 mm.; mastoid breadth,

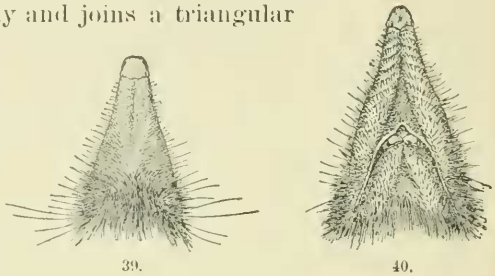
[1] Exclusive of the claw in both cases.

10.4 mm.; breadth between postero-external angles of first molars, 6.1 mm.

Distribution.—Pacific Coast of North America west of the Cascade and Sierra Nevada Mountains, from Fraser River, British Columbia, to Shasta County, California, and thence southward along the coast to San Francisco Bay.

DESCRIPTION.[1]

Body depressed. Head conical, with an elongated snout, which is rugose, naked above as far back as the line of the incisors, and terminates in a pad or button. Nostrils comma-shaped, lateral, in the sides of the lateral pad. Upper lip with a sharp ridge, which is emarginate anteriorly and joins a triangular naked median area which runs forward to the end of the snout, as in *Parascalops* and *Scalops*.



39. 40.

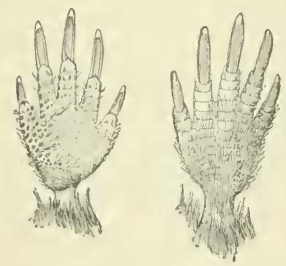
SNOUT OF NEÜROTRICHUS GIBBSII.

Fig. 39, Upper surface. Fig. 40, Lower surface.

(Twice natural size.)

Eye moderately large for this family, concealed in the fur, but not covered by membrane; situated above and somewhat behind the corner of the mouth. No external ear. Auricular orifice large, of varying contour, according as the surrounding integuments are tense or lax.

Fore feet broad, scaly above and warty below; palm longer than broad. Back of the toes each with three or four large scales. Toes not webbed. Second, third, and fourth toes subequal and largest, with broad acute nearly straight claws which are half as long as the palm. First and fifth toes shorter and with shorter claws. Fifth claw reaching to the base of the fourth; the first to the middle of the second.



41. 42.

FORE FOOT OF NEÜROTRICHUS GIBBSII.

Fig. 41, Lower surface. Fig. 42, Upper surface.

(Twice natural size.)

Hind feet nearly twice as long as the fore feet, narrow; covered above with rounded scales and sparse hairs; below scaly, naked, with six tubercles, of which one is at the base of the conjoined third and fourth toes, one at the base of the second and third toes, two others at bases of first, second, and fifth toes, respectively, and two more near the middle of the sole. Second and fourth toes subequal and longest; first and fifth shorter.

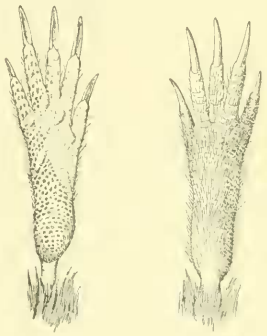
Claws of the second, third, and fourth toes as long as the toes themselves, compressed, acute, gently curved and twisted inward at the

[1] No. 10717, U.S.N.M. Simiahmoo, Wash. Male, young. Alcoholic.

extremities. Claws of the first and fifth toes much shorter. First toe placed farther back than the others, so that its claw does not reach to the base of the second toe. Claw of fifth toe reaches to the base of the fourth toe.

Tail a little more than twice as long as the hind foot (with the claw); terete, constricted at the base, covered with about 63 rows of scales and with long hairs which do not conceal the scales.

Fur all of one kind, consisting of long hairs of different diameters, which are dull and irregularly crenulate below, with long shining tips. Color dusky brown throughout, with hoary and purple reflections. The hairs of the feet and tail are dusky like the fur of the body. Young apparently paler and browner.



43. 44.

HIND FOOT OF NEÜROTRICHUS GIBBSII.

Fig. 43, Lower surface. Fig. 44, Upper surface. (Twice natural size.)

SKULL.

Skull conical and depressed, smooth and without prominent crests or ridges. Rostrum moderately elongated, flattened superiorly. Nasals emarginate in front and much shorter than the intermaxillæ. Zygomatic arches short, slender, slightly convex upward and inserted high up posteriorly. Infraorbital foramen large, having the minute lachrymal foramen above its anterior margin.

45.

TAIL OF NEÜROTRICHUS GIBBSII. (Natural size.)

Nasals short and broad, with moderate sinuses. Parietals irregularly pentagonal, the longest side in the median line. Occipital large and broad with two large lobes which reach forward to join the emarginate posterior border of the parietals. Squamosals low, and very irregular in form, with a broad quadrate portion above the tympanic bullæ. Foramen magnum large, oval. Tympanic bullæ, annular, broadest antero-internally. Palate concave with an emarginate posterior border opposite the last molar. Horizontal ramus of mandible nearly straight, slender. Coronoid process large, high, and strongly hooked. Angle similar in form, but smaller.

TEETH.

I, $\frac{3}{3}$; c, $\frac{1}{1}$; pm, $\frac{2}{2}$; m, $\frac{3}{3}$; total, 36. First upper incisors orbicular, much larger than the second and third. The latter subequal and smaller than the canine, which is two rooted and triangular, with a slight posterior accessory cusp. First premolar one-third smaller than and of like form with the canine; much smaller than the second premolar. The latter is a large triangular tooth with a prominent internal basal tubercle or heel. Molars of normal form; the internal basal cusp of the first and second bilobed.

All the mandibular teeth to the last premolar with oblique crowns. Crowns of the three incisors broad, decreasing in size from the first to the third. Canine similar to the third incisor, but smaller, and with a posterior basal tubercle. First premolar large and thicker and less oblique. Second premolar very much larger and more massive; nearly conical, but with a posterior basal prolongation. Molars W-shaped in transverse section, longer than broad; the first and second subequal and the third one-third smaller.

GEOGRAPHICAL DISTRIBUTION.

I have examined in all 51 specimens of this mole. These specimens are from widely remote localities, and I am disposed to think that they indicate fairly well the present range of the species, except that there is likely to be a further southward extension in the Sierra Nevadas.

The type of the species was from the White River Pass, north of Mount Rainier, Washington, and there is another specimen in the National Museum from Simiahmoo in the same State, and 34 specimens from Sumas, British Columbia, on the south side of the Fraser River (long. 122° W.).

In the Department of Agriculture collection are eight specimens from Washington, two from Steilacoom, four from Lake Cushman, in the northwest part of Mason County, on the Skokomish River; one from Tenino, and one from Seattle. The National Museum has one specimen from Elkhead, Douglas County, Oregon, and the Department of Agriculture one from Siskiyou in that State. The remainder of the specimens are from northern California; one from Crescent City (D. A.); three from Carberry's Ranch (D. A.), which is on the summit of the Sierra Nevada Mountains, about 50 miles east of Redding; two from Nicasio, Marin County (1 D. A., 1 A. M.).

Lord met with the species in British Columbia on the Sumas (or Chilliwack) prairies on the west side of the Cascade Mountains, near the Fraser River, probably on the identical spot from which the large series in the National Museum was obtained.[1]

Dobson includes Texas in the range of the species,[2] but on what grounds I do not know.

From present evidence it would appear that the range of *Neürotrichus* covers an area on the Pacific Coast of North America west of the Cascade and Sierra Nevada Mountains, extending from the Fraser River in British Columbia, immediately north of the boundary of the United States, to San Francisco Bay. At two points, namely, at the

[1]Proc. Zool. Soc. London, 1864, 161. "The first and only place in which I ever met this strange little fellow was on the [Chilliwack] prairies. These large grassy openings or prairies are situated near the Fraser River, on the western side of the Cascade Mountains." (LORD, Naturalist in British Columbia, I, 1866, p. 341, with a plate.)

[2]Monogr. Insectivora, 1883, p. 143.

White River Pass, Washington, and at Carberry's Ranch, California, the range is known to extend into the mountains, and the species may yet be found on the east side and also farther south in the Sierra Nevadas. No specimens have been found in the Sacramento Valley, however, and it will perhaps be found that south of Carberry's Ranch, at the junction of the Sierra Nevada and coast ranges, the eastern boundary follows the line of the latter rather than the former.

GEOGRAPHICAL DISTRIBUTION OF NEÜROTRICHUS.

GEOGRAPHICAL VARIATION.

The specimens at hand are not sufficient for demonstrating the extent of the variation in *Neürotrichus*. The indications, however, are that there is only a slight variation in size, and certainly no important variation in color. The only considerable series of specimens from one locality is that from Sumas, British Columbia. This includes 12 males and 21 females, which are adult or nearly so. The average and maximum dimensions of these according to the collector's measurements are as follows:

Measurements.	Average.	Maximum.
MALES.	*mm.*	*mm.*
Total length	111.5	116.0
Tail	37.1	40.0
Hind foot	16.5	17.5
FEMALES.		
Total length	114.4	123.0
Tail	37.1	41.5
Hind foot	16.6	17.5

It will be seen that the average total length of the females is a little greater than that of the males, which is probably due to the presence of more well developed individuals among the former than the latter in the series, and not to any real difference in size between the sexes, seeing that the average length of tail and hind foot is practically identical in both sexes. At all events the averages for the combined series of 33 specimens are as follows: Total length, 113.6 mm.; tail, 37.1 mm.; hind foot, 16.6 mm. The maximums are as follows: Total length, 123 mm.; tail, 41.5 mm.; hind foot, 17.5 mm. I have measurements of only one fresh specimen from farther south to compare with these. It is from Marin County, California (No. 2585, A. M.): Total length, 117.5 mm.; tail, 38.1 mm. It will be seen that this exceeds the average of the Sumas series, but falls short of the maximum. So far as it goes, therefore, it does not indicate any increase in size southward.

The skull of this California specimen exceeds that of the Sumas specimen, which has the maximum external proportions by eight-tenths of a millimeter, and is the largest skull examined. There is only one other complete adult California skull (No. 24010, D. A., Crescent City, California), and this equals the largest of the Sumas series, and exceeds the average of the same by four-tenths of a millimeter.

Measurements of six dry skins from Washington and three from California, all by the same collector, give the following results:

Measurements.	Average, 6 specimens, Washington.	Average, 3 specimens, California.
	mm.	*mm.*
Total length	114.0	125.6
Length of tail	39.9	45.5
Length of hind foot (without claw)	13.0	14.1

These dimensions are probably nearly correct, and would appear to indicate a more considerable increase southward than is shown by the other data, but as in the case of all dry skins, results from measurements are likely to prove unreliable.

It is probably safe to assume that there is a slight increase in size toward the South in this species.

DATES OF MOLT.

The specimens of *Neürotrichus* examined give some indication of the periods of changing the fur, but are not sufficient to determine the dates with exactitude. A male from Steilacoom, Washington, taken October 12, has new fur concealed on the posterior half of the back and old fur elsewhere. Another individual from the same place (and supposed to be a female), taken October 9, has the change much further advanced, the new fur covering all the back. The under surfaces still retain the old fur. All that can be learned from these two specimens is that the fall molt takes place in October. Why the female is so much further advanced than the male is not explainable.

An old individual (probably a male) from Sumas, British Columbia, taken April 19, has the new fur concealed under the old over the whole body. Another old male from the same locality, taken April 20, has an isolated area of short fur on the back of the neck, but I am in doubt as to whether this is a genuine evidence of molting. The series from Sumas comprises thirty-four specimens with dates from April 12 to June 21, but I have been unable to find any evidences of molting other than those mentioned. From this I can only suppose that the change, except in very old individuals, does not begin earlier than the last week in June at the northern limit of the range of the species.

A larger number of specimens were taken in spring and several of these are molting. One is from Lake Cushman, Washington (a male), taken June 23, and has entire new fur, except a small area above the base of the tail and another on the right flank. Two other males taken at the same place, June 21 and June 27, respectively, appear to have completed or practically completed the molt. From these specimens it would appear that the spring molt in this northern locality is not ordinarily completed until the latter part of June. It is earlier further south.

A specimen (male) from Carberry's Ranch, California, on the Sierra Nevadas, taken May 23, has nearly completed the molt, having the old fur only on the posterior half of the back. Two others from the same locality (one known to be a male) taken May 22 and 18, respectively, appear to have completely changed. From this material it is probable that the molt is complete at this point in all ordinary cases prior to the 1st of June.

In Oregon, as might be expected, the change seems to take place at a period intermediate between those of the Washington and California specimens. A male taken June 8 at Siskiyou, Oregon, appears to have new fur entirely.

DESCRIPTION OF THE TYPE SPECIMEN OF NEÏROTRICHUS GIBBSII (BAIRD).

The type of the species is No. $\frac{6\,6\,2}{1\,5\,4\,3}$, U.S.N.M. It was collected by Dr. Suckley in July, 1854, in the White River Pass, north of Mount Rainier, Washington. It is a young individual, as is shown by its size, and by the fact that some of the milk teeth are still retained. The skin appears to be somewhat faded, but is otherwise in good condition, but the skull is badly broken and incomplete.

The head and body measured on the skin are 56.5 mm.; the tail vertebræ, 33 mm., and the hind foot (without the claw), 12.4 mm.

The skull, as already stated, retains the majority of the milk teeth. The milk incisors and canine are small unicuspidate single-rooted teeth. The second upper milk premolar is a large two-rooted tooth, of the same triangular form as its permanent successor. The first premolar is smaller, but still as large as the permanent one, and like it also two-rooted.

The lower milk incisors are absent. The canine is small and unicuspidate. The first premolar is two-rooted and about as large as the permanent one and probably of similar shape, but it is considerably worn down so that its original form can not be made out. The same is true of the second milk premolar, which is two-rooted and as large as its successor.[1]

46.

JAWS OF TYPE OF NEÜROTRICHUS GIBBSII.

2½ times natural size.

HISTORY OF THE SPECIES.

The history of Gibbs's mole is very simple. The species was first described by Professor Baird, in 1857,[2] from a young specimen obtained by Dr. Suckley in the White River Pass, Washington. It was placed in the Japanese genus *Urotrichus*, to which it bears a very close external resemblance. In 1880 Dr. Günther called attention to the differences in dentition, and established the genus *Neürotrichus* for the American form.[3] Since that date no changes have been made in the status of the form, but probably from lack of specimens in European museums the validity of Dr. Günther's genus has not been so generally recognized as it deserves to be.

Dimensions of skulls of Neürotrichus gibbsii.

Catalogue number. Skull.	Catalogue number. Skin.	Collection.	Locality.	Sex.	Total length.	Basilar length (Hensel).	Length of palate from inside first incisor.	Mastoid breadth.	Greatest zygomatic breadth.	Breadth between postero-external angles of first molars.	Height of coronoid process.	Age.
					Mm.	*Mm.*	*Mm.*	*Mm.*	*Mm.*	*Mm.*	*Mm.*	
62952	....	Nat. Mus ...	Sumas, B. C	♂	23.0	18.3	10.0	10.3	8.4	6.2	3.0	Adult.
62126	.....	do	.....do	♂	22.3	18.2	9.7	10.5	8.3	6.0	2.6	Do.
62432	.....	do	.....do	♂	22.5	18.2	10.0	10.1	8.0	5.7	2.7	Do.
62429	.....	do	.....do	♂	22.7	18.2	10.0	10.5	.....	6.0	2.6	Do.
62436	.....	do	.....do	♂	22.5	18.2	10.0	10.2	8.1	6.0	2.8	Do.
62965	.....	do	.....do	♂	23.2	18.4	10.0	10.4	8.2	5.8	2.7	Do.
62963	.....	do	.....do	♀	23.0	18.3	9.8	10.7	8.2	6.0	2.8	Do.
62953	.....	do	.....do	♀	23.2	18.6	10.1	10.6	8.6	6.4	2.7	Do.
62434	....	.... do	.....do	♀	23.0	18.8	10.0	10.4	8.2	6.3	2.6	Do.
62462	.....	do	.....do	♀	23.0	18.0	10.0	10.6	8.3	6.3	2.9	Do.
62430	.....	do	.....do	♀	23.0	18.0	9.7	10.2	8.2	6.2	2.8	Do.
62954	.....	do	.....do	♀	22.4	18.0	10.0	10.2	.....	6.0	2.5	Do.
43326	31461	Dept. Agric.	Steilacoom, Wash...	♂	22.5	18.3	10.0	10.4	8.0	5.7	3.0	Adult, or less.
43325	31460	.....do	Tenino Wash.....	♂	21.5	17.0	9.2	10.0	.....	6.0	2.6	Do.
65707	.....	.... do	Siskiyou, Oreg	♂	22.4	18.0	9.7	10.8	.....	6.0	2.7	Do.
21010	.....	.....do	Crescent City, Cal...	♂	23.2	18.0	9.6	11.0	.....	6.2	2.8	Youngish?
65322	.....	.... do	Carberry Ranch, Cal	...	.....	17.6	9.0	.....	8.2	6.0	2.6	Adult. or less.
1602	2585	Amer. Mus .	Nicasio, Cal.....	♀	24.0	.....	.....	11.2	.....	.....	.....	Do.
4993	1509	Merriam	.....do	♂	.....	.....	10.0	.....	.....	6.2	.....	Adult.

[1] The skull from Crescent City, California, retains the upper milk canine behind the permanent one on each side.

[2] Rept. Pacific R. R. Survey, VIII, 1857, p. 76, pl. XXVIII.

[3] Proc. Zool. Soc., 1880, p. 441, pl. XLII.

1. LIST OF THE PRINCIPAL GENERAL WORKS IN WHICH THE HABITS, ANATOMY, AND CLASSIFICATION OF THE AMERICAN MOLES ARE MORE OR LESS FULLY DISCUSSED.

1846–1854. AUDUBON, J. J., and BACHMAN, J.—The Viviparous Quadrupeds of North America. 3 vols. 4°. 1846–1854.

Contains descriptions of most of the species, together with extensive accounts of habits, and notes on distribution and taxonomy.

1859. BAIRD, S. F.—Mammals of North America; the descriptions of species based chiefly on the collections in the Museum of the Smithsonian Institution. 4°. 1859.

Contains descriptions of the majority of American species of moles, with measurements and lists of specimens and also figures of the skulls and principal external parts.

1842. DEKAY, JAMES E.—Zoology of New York, or the New York Fauna. Part I, Mammalia. 4°. 1842.

Contains descriptions and figures of *Scalops aquaticus* and *Condylura cristata*, and brief notes on habits.

1883. DOBSON, G. E.—A monograph of the Insectivora, systematic and anatomical. Part 2, including the families Potamogalidæ, Chrysochloridæ, and Talpidæ. 4°. 1883.

Includes full descriptions of the American moles, and an account of the anatomy of *Scalops*, *Scapanus*, and *Condylura*, and figures of the skulls, muscles, and viscera.

1869. FITZINGER, L. J.—Die natürliche Familie der Maulwurfe und ihre Arten, nach kritischen Untersuchungen.

Sitzungsber. Math. Nat. Clas. K. Akad. Wissensch., Wien, (1) LIX, 1869, pp. 353–429.

1875. GILL, THEO.—Synopsis of Insectivorous mammals.

Bull. Geol. and Geog. Survey of the Territories, No. 2, second series, 1875, pp. 91–120.

Comprises a review of the literature and classification of the insectivores, including American forms, together with brief bibliography of works relating to American moles and shrews.

1826–1828. GODMAN, JOHN.—American Natural History. Mastology. 3 vols. 8°. 1826–1828.

Contains descriptions of *Condylura cristata* and *Scalops aquaticus*, and an account of the habits of the latter.

1825. HARLAN, RICHARD.—Fauna Americana. 8°. 1825.

Includes descriptions of American moles.

1856. KENNICOTT, R.—Zoology of Illinois. The silvery shrew mole, or ground mole of Illinois—*Scalops argentatus*, Aud. & Bach.

Prairie Farmer (newspaper), XVI, No. 50, Dec. 11, 1856.

1884. MERRIAM, C. H.—The Vertebrates of the Adirondack region.

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EXPLANATION OF PLATES.

[Figures all one and one-half times natural size.]

PLATE I.

Fig. 1. *Scalops aquaticus machrinus.* No. 36555, U. S. N. M. Male, adult. Warsaw, Ill.

Fig. 2. *Scalops aquaticus texanus.* No. $\frac{5123}{6515}$, Amer. Mus. Female, adult. Rockport, Tex.

Fig. 3. *Scalops aquaticus.* (Typical.) No. 4851, U. S. N. M. Adult. Carlisle, Pa.

Fig. 4. *Scalops aquaticus australis.* No. 2990, Amer. Mus. Adult. Gainesville, Fla. (Type of the subspecies.)

Fig. 5. *Scapanus anthonyi.* No. 4947, Amer. Mus. Male, adult. San Pedro Martir Mountains, Lower California. (Type of the species.)

Fig. 6. *Scapanus californicus.* No. 3111, U. S. N. M. Adult. San Francisco, Cal.

Fig. 7. *Scapanus californicus.* No. 65187, Dept. of Agric. Male, adult. Nicasio, Cal.

Fig. 8. *Scapanus orarius.* No. 3480, Miller Coll. Female, adult. Sumas, British Columbia.

Fig. 9. *Scapanus townsendi.* No. 43330, Dept. of Agric. Male, adult. Tenino, Wash.

PLATE II.

Fig. 1. *Scalops aquaticus machrinus.* No. 36555, U. S. N. M. Male, adult. Warsaw, Ill.

Fig. 2. *Scalops aquaticus texanus.* No. $\frac{5123}{6515}$, Amer. Mus. Female. Rockport, Tex.

Fig. 3. *Scalops aquaticus.* (Typical.) No. 4851, U. S. N. M. Adult. Carlisle, Pa.

Fig. 4. *Scalops aquaticus australis.* No. 2990, Amer. Mus. Adult. Gainesville, Fla. (Type of the species.)

Fig. 5. *Scapanus californicus.* No. 1286, Merriam Coll. Fort Klamath, Oreg. (Type of *S. dilatus.*)

Fig. 6. *Scapanus anthonyi.* No. 4947, Amer. Mus. Male, adult. San Pedro Martir Mountains, Lower California. (Type of the species.)

Fig. 7. *Scapanus californicus.* No. 65184, Dept. of Agric. Male, adult. Nicasio, Cal.

Fig. 8. *Scapanus orarius.* No. 3480, Miller Coll. Female, adult. Sumas, British Columbia.

Fig. 9. *Scapanus townsendi.* No. 43330, Dept. of Agric. Male, adult. Tenino, Wash.

Fig. 10. *Scapanus californicus.* No. 1286, Merr. Coll. Adult. Fort Klamath, Oreg. (Type of *S. dilatus.*)

PLATE III.

Fig. 1. *Scalops aquaticus machrinus*. No. 36555, U. S. N. M. Male, adult. Warsaw, Ill.
Fig. 2. *Scalops aquaticus texanus*. No. $\frac{51}{65}\frac{3}{1}\frac{4}{5}$, Amer. Mus. Female. Rockport, Tex.
Fig. 3. *Scalops aquaticus*. (Typical.) No. 4851, U. S. N. M. Adult. Carlisle, Pa.
Fig. 4. *Scalops aquaticus australis*. No. 2990, Amer. Mus. Adult. Gainesville, Fla. (Type of the subspecies.)
Fig. 5. *Scalops aquaticus australis*. No. 1468, Rhoads Coll. Tarpon Springs, Fla. (Type of *S. parvus*.)[1]
Fig. 6. *Scapanus anthonyi*. No. 4947, Amer. Mus. Male, adult. San Pedro Martir Mountains, Lower California. (Type of the species.)
Fig. 7. *Scapanus californicus*. No. 3111, U. S. N. M. San Francisco, Cal.
Fig. 8. *Scapanus californicus*. No. 65187. Dept. of Agric. Male. Nicasio, Cal.
Fig. 9. *Scapanus orarius*. No. 3480, Miller Coll. Female, adult. Sumas, British Columbia.
Fig. 10. *Scapanus townsendi*. No. 43330, Dept. of Agric. Male, adult. Tenino, Wash.

PLATE IV.

Figs. 1–3. *Parascalops breweri*. No. 57086, Dept. of Agric. Female. Magnetic City, N. C.
Figs. 4–6. *Condylura cristata*. No. 1012, Merriam Coll. Female, adult.
Figs. 7–9. *Neürotrichus gibbsii*. No. 65707, Dept. of Agric. Male. Siskiyou, Oreg.

[1]This figure was made under the supervision of Mr. Rhoads, by Mr. Von Iterson, in Philadelphia. All the others are by Dr. J. C. McConnell, and were corrected by myself. The text figures were drawn by Mr. A. H. Baldwin.